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VOLUME 12, NUMBER 18 SEPTEMBER 15, 1979

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SELECTED WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center, Office of Water Research and Technology, U.S. Department of the Interior



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VOLUME 12, NUMBER 18 SEPTEMBER 15, 1979

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he Secretary of the U.S. Department of the Interior has dermined that the publication of the periodical is necessary in the ansaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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FOREWORD

SELECTED WATER RESOURCES ABSTRACTS

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the Water Resources Thesaurus. Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT PRESENTLY IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstract-

ing, and indexing from the current and earlier pertinent literature in specified subject areas.

Additional "centers of competence" have been established in cooperation with the Environmental Protection Agency. A directory of the Centers appears on the inside back cover.

Supplementary documentation is being secured from established discipline-oriented abstracting and indexing services. Currently an arrangement is in effect whereby the Bio-Science Information Service of Biological Abstracts supplies WRSIC with relevant references from the several subject areas of interest to our users. In addition to Biological Abstracts, references are acquired from Bioresearch Index which are without abstracts and therefore also appear abstractless in SWRA. Similar arrangements with other producers of abstracts are contemplated as planned augmentation of the information base.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangements of this bulletin are welcome.

Water Resources Scientific Information Center Office of Water Research and Technology U.S. Department of the Interior Washington, DC 20240

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ave bar igotech	Please use the edge index on the back cover to locate Subject Fields and Indexes.
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02	WATER CYCLE
Mean At	Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.
03	WATER SUPPLY AUGMENTATION AND CONSERVATION
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05	WATER QUALITY MANAGEMENT AND PROTECTION Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration;
	Water Quality Control. 200029 Doi: 200029 Doi: 200029 Description of the Control
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THE ESTI CHARGE, Birmingham neering. K. R. Rusht Journal of I May 1979.

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ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

THE ESTIMATION OF GROUNDWATER RE-CHARGE, Birmingham Univ. (England). Dept. of Civil Engi-

neering. K. R. Rushton, and C. Ward. Journal of Hydrology, Vol. 41, No. 3/4, p 345-361, May 1979. 6 fig, 4 tab, 16 ref.

Descriptors: "Groundwater recharge, "Methodology, "Estimating, "Hydrologic budget, Model studies, Water balance, Evapotranspiration, Soil moisture, Precipitation/Atmospheric), Runoff, Vegetation effects, Foreign countries, Foreign research, "England, Penman method, Grindley method, Chalk aquifer.

Methods of estimating groundwater recharge in temperate climates were reviewed, and it was sug-gested that the conventional method of Penman gested that the conventional method of Penman and Grindley tends to under-estimate the recharge. An alternative recharge mechanism was proposed which allows recharge to occur even when a soil moisture deficit exists. The implications of this approach were examined by considering a Chalk aquifer in North Lincolnshire. (Visocky ISWS) W79-08566

DIURNAL VARIATIONS IN STREAM DIS-CHARGE AND THROUGHFLOW DURING A PERIOD OF LOW FLOW, Huddersfield Polytechnic (England). Dept. of Ge-

ography. T. P. Burt. Journal of Hydrology, Vol. 41, No. 3/4, p 291-301, May 1979. 9 fig. 10 ref.

Descriptors: *Low flow, *Streamflow, *Discharge(Water), Hydrologic aspects, Evaporation, Soil water movement, Flow, Droughts, Saturated soils, Diurnal, Soil moisture, Chemical properties, *Throughflow, Chemical concentration.

During the drought of 1976, the hydrological response of Bicknoller Combe, Somerset, England, was characterized by a marked diurnal oscillation of stream discharge. Observations of throughflow also showed a clear diurnal variation. Soil water potential data from tensiometer records indicated a flow reversal to occur with flow towards the soil surface during the day in response to intense eva-potranspiration, and at night indicated the resump-tion of downslope soil water movement. Diurnal oscillation of stream discharge is seen as the direct result of changes in the size of the saturated wedge result of changes in the size of the saturated weapon which are produced by the periodic variation in the rate of evapotranspiration. Observations of di-urnal variation in the solute concentration of stream water also were briefly described. (Lee-ISWS) W79-08568

STREAM GAUGING INFORMATION, AUSTRALIA - FOURTH EDITION, Australian Water Resources Council, Canberra. 1978. 180 p. 1 fig. 10 tab. 2 append. Australian Government Publishing Service, Canberra.

Descriptors: *Stream gages, *Gaging stations, *Hydrography, Water measurement, Australia, Streamflow, Discharge measurement, Stations, Flow measurement, Data collections, On-site data collections, River basins.

Information on the 4951 stations in Australia where hydrographic data are or have been collected is presented in this catalog. Details are given for each station including national gauging station number, location, catchment area, type of data collected, period of record, water quality, the authority collecting the data, and, where available, statistics on the annual discharges of streamflow. Years of commencement and closure, transfers of stream one corporation to another, and stations from one organization to another, and remarks which serve to amplify particular details of a station are also included. Information is ar-

ranged by the twelve drainage divisions, which are subdivided by river basins. Stations are classified as to their use: stream gauge, tidal gauge, flood warning or emergency station, representative basin station, small rural catchment station, or other. Station sites include: streams or natural watercourses, canals, lakes, estuaries, urban areas, and other areas. (Schaefer-IPA)

WATER IN MISSOURI, Department of Natural Resources, Jefferson City, MO. Div. of Geology and Land Survey.

Educational Series No. 5, 1979. 27 p, 19 fig, 3 tab,

Descriptors: *Missouri, *Education, *Hydrologic cycle, *Groundwater, *Surface waters, Water utilization, Water quality, Water supply, Water resources development, Water pollution, Water sources, Reservoirs, Hydroelectric power, Springs, Laker.

One of Missouri's most important natural resources is water. Water moves in a never-ending cycle, circulating among sky, land, ocean, and back to the sky-called the hydrologic cycle. The average annual precipitation in the U.S. is 30 inches, providing 4,200 billion gallons of water per day. About 600 billion gallons per day are available for domestic, industrial, municipal, and agricultural requirements. The nation's daily water use was 420 billion gallons (excluding hydroelectric power) in 1975. In Missouri in 1975, daily water use was 4.1 billion gallons. The sources of water in Missouri are surface water and groundwater. The report defined 'surface water' and 'groundwater', explained how much of each is available, showed what the sources are, and indicated where small, medium, and large quantities of surface water and what the sources are, and indicated where small, medium, and large quantities of surface water and groundwater are found in the state. Also included in the report was a description of water use, water development, and water problems in Missouri. (Froehlich-ISWS)
W79-08613

DISTRIBUTION OF HYDROCARBONS IN NARRAGANSETT BAY SEDIMENT CORES, Rhode Island Univ., Kingston. Graduate School of

Rhode Island Univ., Ringston. Graduate School of Oceanography.

A. C. Hurtt, and J. G. Quinn.
Environmental Sciences and Technology, Vol. 13,
No. 7, p 829-836, July 1979. 8 fig, 2 tab, 27 ref.
NSGP 04715844088.

Descriptors: *Organic compounds, *Rhode Island, *Sediments, *Cores, *Estuaries, Bays, Sampling, Oil, Oil spills, Pollutants, Water pollution, Water pollution sources, Chemicals, Chemical analysis, Chromatography, Sedimentation, Depth, Distribution patterns, Spatial distribution, *Narragansett Bay(RI).

Twenty cores were analyzed to provide data on the distribution of sedimentary hydrocarbons from various areas of Narragansett Bay. There was a decrease in surface (0-5 cm) sediment hydrocarbons from the Providence River to the mouth of the bay, and the concentrations also decreased with depth in the cores, generally levelling off at 20-25 cm. This depth is probably related to increased petroleum utilization at the end of the 19th century. Several areas of the bay showed increasing hydrocarbons with depth, but the exact cause of this phenomenon could not be determined. The results of this study indicated that the major source of anthropogenic hydrocarbons in bay sediments is the Providence River. These compounds are introduced into the bay via tidal transport of suspended material from the river and undergo gradual sedimentation throughout the estuary. (Sims-ISWS) W79-08625

RELATIONSHIPS BETWEEN SMALL WATER BODIES AND GROUNDWATER, New Hampshire Univ., Durham. Inst. of Natural

and Environmental Resources. F. R. Hall.

In: Advances in Groundwater Hydrology; Pro-

ceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 248-261, September 1976. 3 fig, 1 tab, 32 ref.

Descriptors: *Surface-groundwater relationships, *Lakes, *Groundwater movement, *Water bal-ance, Ponds, Groundwater, Analytical techniques, Mathematical models, Methodology, Hydrologic

cycle, Flow.

The purpose of this paper was to outline the important factors which determine whether a lake receives groundwater inflow, contributes to groundwater outflow, or both. The emphasis was on the movement of water and the flow paths followed. Therefore, the energy or head distribution within the aquifer was of major interest. Emphasis was placed on natural, permanent ponds and small lakes which are situated in unconsolidated sediments overlying an impermeable bedrock and which are located in subhumid or humid regions. Groundwater flow was assumed to occur mainly under unconfined conditions. Knowledge is required of the subsurface stratigraphy and the values for the various layers and lenses of permeability, permeability contrasts, and anisotropy. In practice, difficulties arise in obtaining this knowledge even with fairly complete studies. A reasonably detailed water balance of the water body allows evaluation of the possibilities for groundwater inflow and/or outflow. Groundwater flow simulations by digital computer, particularly for steady conditions in vertical section, are useful in conceptualizing the situation of interest. Needless to say, the results of such simulations should carefully interpreted in the light of available field evidence. (See also W.79.08631). [Humphreys.15WS] fully interpreted in the light of available field evidence. (See also W79-08631) (Humphreys-ISWS) W79-08650

REPRESENTING STREAM AQUIFER INTER-

Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering. For primary bibliographic entry see Field 2F. W79-08651

STOCHASTIC MANAGEMENT OF A STREAM-

AQUIFER SYSTEM,
Universidad Nacional Automona de Mexico,
Mexico City. Inst. de Geofisica. For primary bibliographic entry see Field 6A. W79-08655

COOPER RIVER ENVIRONMENTAL STUDY, South Carolina Water Resources Commission, Co-For primary bibliographic entry see Field 4A. W79-08830

2B. Precipitation

URBAN EFFECTS ON PRECIPITATION: A REVIEW, Natal Univ., Durban (South Africa). Dept. of Geography. R. D. Diab.

South African Journal of Science, Vol. 74, No. 3, p 87-91, March 1978. 3 fig. 57 ref.

Descriptors: *Precipitation(Atmospheric), *Cities, "Weather patterns, Metropolitan Meteorological Experiment(METROMEX), Local precipitation, Meteorology, Rainfall, Urbanization, Condensation, Meteoric water, Weather data, Climatology.

The suggested causal mechanisms underlying observed precipitation anomalies over cities are examined, and the historical development of urban precipitation studies is traced. Four possible modifications of the atmosphere may be responsible for urban-induced changes in precipitation: (1) in-creased thermal mixing due to the effects of the well-established heat island and anthropogenic heat input, (2) increased mechanical mixing due to greater aerodynamic roughness of urban struc-tures, (3) changes in low-level atmospheric mois-

Group 2B-Precipitation

ture content, and (4) the addition of condensation and ice nuclei from industrial and motor vehicle discharges. In 1971, in response to a well-recog-nized need, METROMEX (Metropolitan Meteorological Experiment) was initiated to study the effects of urbanization on precipitation. The three objectives of METROMEX were to determine the objectives of METROMEX were to determine the reality of precipitation anomalies, to determine the factors responsible for the observed anomalies, and to develop models capable of predicting urban precipitation anomalies. The results from METROMEX strongly suggest that modifications in the precipitation process can be caused by urban areas and their associated thermodynamic, mechanical, and atmospheric compositional changes. The exact magnitude of this relationship is still uncertain due to effects of topography and variability of rainfall. (Schaefer-IPA)

HYDROLOGICAL, METEOROLOGICAL, AND AGRICULTURAL RELATIONS IN NORTHERN IRAQ,

Ministry of Irrigation, Baghdad (Iraq). For primary bibliographic entry see Field 3F. W79-08561

A TECHNIQUE FOR THE DIRECT MEASURE-MENT OF WATER STORAGE ON A FOREST CANOPY.

University of Strathclyde, Glasgow (Scotland).

Oniversity of Strathciyae, Giasgow (Scotland). Dept. of Applied Physics. N. H. Hancock, and J. M. Crowther. Journal of Hydrology, Vol. 41, No. 1/2, p 105-122, April 1979. 7 fig. 1 tab, 19 ref.

Descriptors: *Canopy, *Water storage, *Forests, Technology, Storage, Hydrology, On-site investigations, Calibrations, Measurement, Meteorology, Trees, Equations, *Hafren Forest(Wales), *Wales, Hydrometeorological variable, Sitka Water-laden branch, Cantilever deflection.

A method was presented for the continuous measurement of water stored on a forest canopy located in Hafren Forest, Wales. The novel method used the cantilever deflection of a water-laden branch. A description of the necessary instrumen-tation was presented, and the validity was demon-strated. Calibration methods and results were discussed, and the extrapolation from individual branches to a complete canopy was considered. A branches to a complete canopy was consucered. A description was given of a continuous two-year experiment, and a sample of the recorded data was shown and analyzed for canopy water storage. In particular, a storage capacity of 2.5 + or -0.4 mm was found for a closed Sitka spruce canopy. A preliminary analysis of dynamic events allowed a test of some of the hypotheses made in a Rutter model. In particular, the exponential form of evaporation from a completely wet but unsaturated canopy was verified, and aerodynamic resistance values were calculated directly. (Roberts-ISWS) W79-08577

DISTRIBUTION OF HYDROCARBONS IN NARRAGANSETT BAY SEDIMENT CORES, Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 2A.
W79-08625

2C. Snow, Ice, and Frost

SNOWPACK GROUND TRUTH, DONNER PASS SITE, SODA SPRINGS, CALIFORNIA, JANUARY 18, 1977,

Bittinger (M.W.) and Associates, Inc., Fort Collins, CO.

E. B. Jones

Available from the National Technical Information Service, Springfield, VA 22161 as N77-25605, Price codes: A02 in paper copy, A01 in microfiche, Mission Report, February 1977. 13 p, 4 fig, 4 tab.

Descriptors: *Snowpacks, *Surveys, *California, Snow, On-site investigations, Depth, Strength, Density, Moisture content, Crystals, Mountains,

Snow surveys, Snow cover, Remote sensing, Aircraft, *Donner Pass(CA), *Soda Springs(CA).

This report contained the ground-truth data taken near Soda Springs, California, in support of the NASA Airborne Instrumentation Research Pro-gram. The location of the Donner Pass Site is just southeast of Soda Springs, California. The flight line traversed much of Lake Van Norden. The dam on Lake Van Norden has been breached in such a manner as to prevent the storage of water. For this reason, much of the flight line passed over the former lake bed. Ground-truth data taken in the former lake bed. Ground-truth data taken in support of this mission were as follows: (1) snow depths were taken every 400 feet; (2) snow densities were taken every 1200 feet; (3) two snowpits were dug, and limited density, vertical layer classifications, and soil observations were taken; and (4) temperatures of the upper 6 inches of the snow-pack were taken at one location. (Sims-ISWS) W79-08548

TEMPERATURE PATTERNS IN AN ALPINE SNOW COVER AND THEIR INFLUENCE ON SNOW METAMORPHISM,

Colorado Univ., Boulder.

Colorado Univ., Boulder. Inst. of Arctic and Alpine Research. E. R. La Chapelle, and R. L. Armstrong. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A040 169, Price codes: A03 in paper copy, A01 in microfiche. Technical Report, February 1977. 37 p. 15 fig. 3 tab, 10 ref. ARO DAHC04-75-G-0028, DAHG29-76-G-0028.

Descriptors: *Snow, *Snow cover, *Temperature, *Colorado, *Model studies, Snow packs, Strength, Crystals, Radiation, Solar radiation, Heating, Mathematical models, On-site investigations, Sampling, Data processing, Meteorology, *Snow metamorphism, Recrystallization.

Spatial and temporal variations of temperature in alpine snow covers were systematically observed over a period of two winters. Concurrently, snow crystal metamorphism was monitored in the same snow covers, along with such basic snow proper-ties as density and ram resistance. Near-surface snow temperatures fluctuate widely in response to diurnal weather variations. Below surface about 25 cm, the temperatures change more slowly in re-sponse to longer-term weather trends. Mean snow temperatures are colder on north slopes than south ones, but mean snow cover temperature gradients are similar on both exposures owing to shallower snow on south slopes. A forest canopy tends to suppress snow surface radiation cooling and hence magnitude of temperature gradients depth. Metamorphism in snow follows a recrystal-lization mode with declining mechanical strength lization mode with declining mechanical strength when the saturation water vapor pressure gradient exceeds 0.05 mb/cm. Owing to a nonlinear vapor pressure-temperature relationship over ice, this corresponds to the conventional critical temperature gradient of 0.1 deg C/cm for this metamorphism mode only at snow temperatures close to the melting point. Mean monthly snow temperature gradients can reasonably be estimated from air temperature and snow depth means, but this method can be extended to vapor pressure gradients only if appropriate corrections for non-linearity are introduced. (Sims-ISWS) W79-08579

WORLD DATA CENTER A FOR GLACIOLOGY (SNOW AND ICE), NEW ACCESSIONS LIST NO. 2.

Colorado Univ., Boulder. Inst. of Arctic and Alpine Research. April 1979. 144 p.

Descriptors: *Glaciology, *Snow, *Ice, Bibliographies, Computers, Snow cover, Glaciers, Avalanches, Polar regions, Sea ice, Permafrost, Abstracts, Data collections, Publications, Paleoglacio-

The quarterly list of documents acquired by the Data Center during the period September-December 1978 has been published. Books, technical reports, conference proceedings and reprints were

included; most journal articles have not yet been indexed. The subject headings were those used by the Army Cold Regions Research and Engineering Laboratory in their Bibliography on Cold Regions Sciences and Technology. Bibliographic items are repeated in their entirety under each appropriate subject heading. (Froelich-ISWS) W79-08612

2D. Evaporation and Transpiration

HAS THE PRIESTLEY-TAYLOR EQUATION ANY RELEVANCE TO FOREST EVAPORATION,

Institute of Hydrology, Wallingford (England). For primary bibliographic entry see Field 2I. W79-08552

THE 'EVAPORATION BRUSH', AN EVAPORI-METER FOR MEASURING THE POTENTIAL EVAPORATION OF MEADOW GRASS, Heidemastchappi BeheerN.V., Arnhem (Nether-lands). Research Dept. C. L. Palland. Journal of Hydrology, Vol. 41, No. 3/4, p 363-369, May 1979. 6 fig, 8 ref.

Descriptors: *Evaporimeters, *Grasses, *Evaporation, Evaportanspiration, Grasslands, On-site investigations, Evaporators, Heat flow, Soil moisture, Instrumentation, *Evaporation brush, *Meadow grass, *The Netherlands, Potential evaporation, Brush fibers, Penman formula, Pertinax, Registration unit, Dalton formula.

A new type of evaporimeter, called the 'evaporation brush', was described. It measures continuously the evaporation rate. The operation of the evaporation brush was tested in a field of meadow grass which is sufficiently supplied with soil moisture. It was found that the evaporation measured by this device in meadow grass during periods of one hour and 24 hours compares well with calculated data for meadow grass from a modified Penman formula. The instrument must be tended only once a week (Roberts-ISWS) week. (Roberts-ISWS) W79-08565

THE ESTIMATION OF GROUNDWATER RE-

Birmingham Univ. (England). Dept. of Civil Engineering. For primary bibliographic entry see Field 2A. W79-08566

SOME OBSERVATIONS ON THE PERIODIC VARIATIONS OF MOISTURE IN STABILISED AND UNSTABILISED SAND DUNES OF THE INDIAN DESERT, Central Arid Zone Research Inst., Jodhpur (India). For primary bibliographic entry see Field 2G.

For primary W79-08573

EVAPORATION OF WATER FROM SAND: THE EFFECT OF EVAPORATION ON THE PRECIPITATION OF SALTS DISSOLVED IN WATER STORED IN SAND, National Inst. for Water Research, Windhoek (South West Africa).

D. H. R. Hellwig.
Journal of Hydrology, Vol. 41, No. 1/2, p 140-151, April 1979. 3 fig, 2 ref.

Descriptors: *Evaporation, *Evaporation pans, *Water, *Sands, Salts, Carbonates, Precipitation (Atmospheric), Rational formula, Rivers, *Precipitation of salts, *Sand beds, Windblown quartz sand, Evaporation tanks, Salt concentration, Cumulative salt increase, Carbonate

The relationship between evaporation of water out of sand beds and the loss of salts from solution was formulated by Hellwig in 1974 as a hyperbolic function. The results of a subsequent experiment did not confirm this relationship. The experimental setup for both experiments was identical to the one

described by used a natu t. a wine le salts, w evaporation sand surface days. The concentratio 1974 test. E line relation CaCO3 as was a conti during rain non-carbons which was resolution o tion and ca erts-ISWS) W79-08574

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Descriptors ric hydrolo Albedo, So Hydrologic n equatio Aquifer(Gr analysis, W Potential e The variou

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roken cha adherence distance ste ant number of accuracy striction of to maintain savings in number allo W79-08556 described by Hellwig earlier in 1973. Hellwig had used a natural river sand in his 1974 test. In contrast, a wind-blown quartz sand, free of acid soluble salts, was used by the author. Results of 8 evaporation tanks, i.e., from 0-700 mm below the sand surface, were evaluated for a period of 847 days. The theoretical and actual increase in the concentration of salts in the water of the evaporation tanks was calculated in the same way as the 1974 test. Both sets of results showed a straight-line relationship that indicated the precipitation of CaCO3 as a result of evaporation of feed water was a continuous process which was not reversed during rainy periods. Also, the precipitation of non-carbonate salts was a continuous process which was temporarily reversed in both tests by resolution of salts during rainy periods. The tests established a straight-line relationship for evaporation and carbonate salts lost from solution. (Roberts-ISWS) W79-08574

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THE SENSITIVITY OF PARAMETERS IN THE PENMAN EVAPORATION EQUATIONS AND DIRECT RECHARGE BALANCE,

Birmingham Univ. (England). Dept. of Geological

K. W. F. Howard, and J. W. Lloyd. Journal of Hydrology, Vol. 41, No. 3/4, p 329-344, May 1979. 3 fig, 4 tab, 20 ref, 1 append.

Descriptors: *Evaporation, *Recharge, *Parametric hydrology, Hydrology, Analysis, Infiltration, Albedo, Soil moisture, Radiation, Temperature, Hydrologic cycle, Equations, *Penman evaporation equations, *Great Britain, *Lincolnshire Chalk Aquifert(Great Britain), Parameters, Sensitivity analysis, Wet-bulb temperature, Capillary forces, Potential evaporation, Daily recharge estimates.

The various parameters in the Penman equations and direct recharge balance were varied to determine their influence on the calculated evaporation and recharge amounts. The sensitivity analysis was applied to data from an area north of the north Lincolnshire Chalk aquifer. Evaporation estimates were found to be particularly sensitive to albedo, radiation constants, and wet-bulb temperatures. The resultant differences, in turn, significantly affected recharge estimates. The study also indicated the need to use daily computations of recharge in place of the normally used ten daily or monthly computations. (Roberts-ISWS)

2E. Streamflow and Runoff

CHANNEL FLOW COMPUTATIONS USING CHARACTERISTICS,
Lanchester Polytechnic, Coventry (England).
Dept. of Civil Engineering.

Dept. of Civil Engineering.

K. Sivaloganathan.

Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY7, Proceedings Paper 14717, p 899-910, July 1979. 3 fig, 3 tab, 19 ref, 2 append.

Descriptors: *Numerical analysis, *Open channel flow, *Unsteady flow, *Flood routing, Hydraulics, Stability, Mathematical models, Model studies, Equations, Streams, Channels, Computers, *Method of characteristics, Differential equations, Finite difference analysis, Courant condition, Com-

The direct formulation of the rectangular grid broken characteristic method can be used without adherence to the Courant condition. When small distance steps are used, time steps with large Courant numbers may be used with relatively little loss of accuracy. Larger distance steps require the retriction of the Courant numbers to smaller values to maintain reasonable accuracies. Considerable savings in computation times are possible as a result. Restriction of the magnitude of the Courant number allowed seems to be needed only from the point of view of accuracy. (Adams-ISWS) W79-08556 W79-08556

MINIMUM STREAM POWER AND RIVER CHANNEL PATTERNS, San Diego State Univ., CA. Dept. of Civil Engi-

neering. For primary bibliographic entry see Field 2J. W79-08567

DIURNAL VARIATIONS IN STREAM DISCHARGE AND THROUGHFLOW DURING A PERIOD OF LOW FLOW, Huddersfield Polytechnic (England). Dept. of Ge-

ography.
For primary bibliographic entry see Field 2A.
W79-08568

A REVIEW OF DATA ESTIMATION PROCE-DURES AND ASSOCIATED ERRORS, Monash Univ., Clayton (Australia). Dept. of Civil

Engineering. T. A. McMahon. Journal of Hydrology, Vol. 14, No. 1/2, p 1-10, April 1979. 3 fig. 26 ref.

Descriptors: *Model studies, *Mathematical models, *Computer models, *Streamflow, Stream gages, Gaging station, Data processing, Mapping, Runoff, Rainfall, Precipitation excess, Hydrology, Data estimation.

Data estimation.

This paper was the outcome of a review carried out within the framework of an analysis concerned with an economic evaluation of Canada's hydrometric network. For this reason, it contained several techniques which are peculiar to Canada, but nevertheless, the conclusions should be universally applicable. Procedures were reviewed for determining monthly flows, basic hydrologic parameters, and characteristics at a gauging station as well as their associated errors. There is a range of techniques that can be used to estimate flows, flow parameters, and characteristics when data are not available or when the record is short. Large errors are involved with some procedures, for example, isolines of mean annual runoff and low flow estimates using regression analysis. It was noted that the more accurate procedures are the more complex. Their applicability depends on the significance of the project and the availability of trained personnel to use the models. (Sims-ISWS)

FLOODPLAIN PAINS, Texas A and M Univ., College Station. For primary bibliographic entry see Field 4A. W79-08597

VARIABILITY OF RUNOFF IN AUSTRALIA, Australian Water Resources Council Canberra. Hydrological Series No. 11, 1978. 45 p, 6 fig, 3 tab, 55 ref, 2 append. Australian Government Publish-ing Service, Canberr.

Descriptors: *Runoff, *Rainfall-runoff relationships, *Streamflow, Australia, Rainfall, Hydrologic data, Water resources, Variability, Mapping, Data collections, Analysis.

Results of the first Australia-wide study of variability of runoff are presented. Maps detail runoff and streamflow; a discussion of the maps is included. Essentially simple techniques were used in the analysis; sophisticated modelling was rejected because of the large areas and range of variables involved. The greater part of the study dealt with annual totals of runoff; monthly totals of stream discharge are also discussed. Stream discharge statistics, maps of mean annual runoff, rainfall maps and statistics, and maps showing landform types or contours were the main data used for the study. Methods used for plotting the isopleths of depth of runoff varied with the type and density of data available. Two indices of relative annual variability were calculated and mapped since the annual percentage values shown on the maps were not by themselves entirely adequate for comparing relative runoff variations at different places. (Schaefer-IPA) W79-08599

Streamflow and Runoff-Group 2E

HYDROLOGIC DROUGHT IN THE HUM-BOLDT BASIN, NEVADA,
Nevada Univ. System, Reno. Desert Research Inst.
V. L. Gupta, and R. J. Pautsch.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB-298 639,
Price codes: A05 in paper copy, A01 in microfiche.
Technical Report, H-W Series No. 35, June 1979.
91 p, 9 fig. 37 tab, 36 ref, 3 append. OWRT A-086-NEV(2), 14-31-0001-8030.

Descriptors: *Droughts, *Hydrologic cycle, Hydrology, Humboldt Basin, Streamflow, Streamflow forecasting, Climatology, Precipitation(Atmospheric), Hydrologic data, Ag-

Precipitation and streamflow in the Humboldt Basin were analyzed for statistical properties such as randomness, cyclical behavior, and wet and dry period clustering effects in order to draw systematic inferences concerning the delineation of drought. There are no standard or unified definitions of drought; for this analysis, drought was defined as a shortage of water supply compared to established or prevailing demand. Loosely defined cycles of approximately 41 and 29 years may be indicated by the serial correlation coefficients for eastern Humboldt Basin precipitation at Elko and Humboldt River streamflow at Palisade which are statistically significant at lags. It is not possible to predict future droughts using cyclical behavior; the best hope for this lies in establishing a correlation. A non-random grouping of dry years for precipitation and a tendency for one very low precipitation year to be followed by another are indicated. Log-extremal (Gumbel) type I and II distributions were used for observed drought-event data and a theoretical curve respectively. The ability of drought flows to meet agricultural demands in the area was also examined. (Schaefer-IPA) W79-08604

A VERIFICATION OF THE QUAL-1 WATER QUALITY MODEL FOR THE LOWER MISSIS-SIPPI RIVER,

Texas Univ. at Arlington. Dept. of Computer Science and Engineering.

For primary bibliographic entry see Field 5B. W79-08616

REPORT OF THE ANNUAL YIELD OF THE ARKANSAS RIVER BASIN FOR THE ARKAN-SAS RIVER BASIN COMPACT, ARKANSAS-OKLAHOMA, 1978 WATER YEAR, Geological Survey, Little Rock, AR. Water Re-sources Div.

For primary bibliographic entry see Field 6E.

ANNUAL PEAK DISCHARGES FROM SMALL DRAINAGE AREAS IN MONTANA THROUGH SEPTEMBER 1978,

Geological Survey, Helena, MT. Water Resources

R. J. Omang, C. Parrett, and J. A. Hull. Geological Survey open-file report 79-522, March 1979. 112 p, 2 fig.

Descriptors: *Annual peak discharge, *Small watersheds, *Montana, *Floods, *Flood frequency, Crest-stage gages, Streamflow, Flow rates, Hydrologic data, *Missouri River basin, *Columbia River

Annual peak stage and discharge data have been collected and tabulated for crest-stage gaging sites in Montana. The crest-stage program was begun in July 1955 to investigate the magnitude and frequency of floods from small drainage areas. The program has expanded from 45 crest-stage gaging stations initially to 173 stations maintained in 1978. Data are tabulated for the period of record. (Woodard-USGS) dard-USGS) W79-08687

Group 2E-Streamflow and Runoff

STREAMFLOW SIMULATION STUDIES OF THE HILLSBOROUGH, ALAFIA, AND AN-CLOTE RIVERS, WEST-CENTRAL FLORIDA, Geological Survey, Tallahassee, FL. Water Resources Div.

J. F. Turner, Jr.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-295 569, Price codes: A08 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-102, 1979. 161 p, 22 fig, 14 tab, 22 ref.

Descriptors: *Streamflow forecasting, *Simulation analysis, *Flood profiles, *Flood peak, *Streamflow forecasting, Hydrographs, Floods, Surfacegroundwater relationships, Watersheds(Basins), Flood control, Computer models, Mathematical models, *West-central Florida, *Soil-moisture accounting, *Reservoir routing, *Channel routing.

A modified version of the Georgia Tech Water-shed Model was applied for the purpose of flow simulation in three large river basins of west-cen-tral Florida. Calibrations were evaluated by comparing the following synthesized and observed data: annual hydrographs for the 1959, 1960, 1973 and 1974 water years, flood hydrographs (maximum daily discharge and flood volume), and long-term annual flood-peak discharges (1950-72). Annual hydrographs, excluding the 1973 water year, were compared using average absolute error in annual runoff and daily flows and correlation coefficients of monthly and daily flows. Correlations coefficients for simulated and observed maximum daily discharges and flood volumes used for calibrating range from 0.91 to 0.98 and average standard errors of estimate range from 18 to 45 percent. Correlation coefficients for simulated and observed annual flood-peak discharges range from and 1974 water years, flood hydrographs (maxiobserved annual flood-peak discharges range from 0.60 to 0.74 and average standard errors of estimate range from 33 to 44 percent. (Woodard-USGS) W79-08692

1977, IN NEW FLOOD OF NOVEMBER 8-10, 197 NORTHEASTERN AND CENTRAL JERSEY,

Geological Survey, Trenton, NJ. Water Resources

R. D. Schopp, and A. J. Velnich. Geological Survey open-file report 79-559, April 1979. 33 p, 5 fig, 4 tab, 7 ref.

Descriptors: "Flood data, "Peak discharge, "Flood profiles, "New Jersey, Streamflow, Flood discharge, Flow rates, Gaging stations, Flood damage, Flood frequency, "Flood-crest data.

This report documents hydrologic and meteorolo-Inis report documents hydrologic and meteorologic aspects of flooding in northeastern and central New Jersey during November 8-10, 1977. Peak stages and discharges at 51 streamflow gaging sites are tabulated and compared to previous maximums. High-water flood crest elevations are presented for eight stream reaches in or near Bergen County where the most severe flooding occurred. While no lives were lost, 21,700 homes were affected and 96 million dollars of damage resulted. (Wooderd, 15GS) (Woodard-USGS) W79-08693

ELEVATIONS AND DISCHARGES PRODUCED BY A SIMULATED FLOOD WAVE ON THE LOWER SABINE RIVER, LOUISIANA AND TEXAS, CAUSED BY A THEORETICAL DAM FAILURE, GEOlogical Support Control of the Contro

Geological Survey, Baton Rouge, LA. Water Resources Div. For primary bibliographic entry see Field 6A. W79-08697

2F. Groundwater

HYDROGEOLOGY OF THE OYEN AREA, AL-BERTA, Research Council of Alberta, Edmonton.

D. M. Borneuf. Report 78-2, 1979. 37 p, 1 map, 30 ref, 1 append.

Descriptors: *Canada, *Hydrogeology, *Ground-water, *Data collections, Aquifers, Maps, Bedrock, Water quality, Vegetation, Grasses, Geology, To-pography, Chemistry. Water chemistry, Climates, Drainage, Nitrates, Fluorides, Iron, Salts, Water yield, *Alberta(Canada), *Oyen(Alberta), Late Cretaceous Age.

The Belly River, Bearpaw, and Horseshoe Canyon Formations of Late Cretaceous age constitute the upper bedrock in the map area. The surficial deupper bedrock in the map area. The surficial deposits are generally quite thin (usually less than 50 ft or 15 m) with the exception of buried valley deposits which can be as much as 500 ft thick (150m). Yields vary from 1 to 25 igpm (0.07 to 2 L/s) over most of the map area in both bedrock and surficial sediments; however, extensive pump testing of the Bulwark sandstones of the Bearpaw Expression in the northwesters corner of the present Formation in the northwestern corner of the map area has indicated a yield range of 25 to 500 igpm (2 to 40 L/s) in a small area. Groundwater quality is generally poor, and areas of salt deposits are very common over all the map area. Lithology for 9 test holes was tabulated in the appendix. (Froehlich-ISWS) W79-08549

HYDRGEOLOGY OF THE BRAZEAU-CANOE RIVER AREA, ALBERTA,

Research Council of Alberta, Edmonton

Report 77-5, 1978. 33 p, 2 tab, 1 map, 34 ref, 1

Descriptors: *Canada, *Hydrogeology, *Rivers, *Data collections, Groundwater, Surface waters, Bedrock, Aquifers, Chemistry, Iron, Fluorides, Water chemistry, Topography, Maps, Drainage, Vegetation, Climates, Ponds, Springs, Wells, Water quality, Water yield, Geology, Karsts, *Brazeau-Cano River(Canada), *Alberta(Canada), Surficial geology.

The hydrogeology of surficial aquifers and shallow bedrock aquifers of the uppermost 500 ft of strata in Brazeau-Canoe River map area was described. Lithology, geologic structure, topographic posi-tion, and climate are the major elements of the hydro-geological regime. Within the Rocky Mountion, and climate are the major elements of the hydro-geological regime. Within the Rocky Mountain Main Ranges and Front Ranges, limestone and dolomite are the dominant rock types. A synthesis of the geologic and geomorphologic characteristics of these rocks indicates that conduits and fractures are the major mode of storage and transmission of groundwater. Thrust faults have a strong influence on valley position and extend for many miles along strike. They have the potential of directing groundwater flow from distant sources toward localized surface discharge points within the valley floors. The valley floors serve as regional and local groundwater drains. The most prospective bedrock aquifers of the Foothills belt occur in the Upper Cretaceous Blairmore Group. Fracture permeability is well developed in thick sandstone units and coal beds. The Upper Cretaceous to Tertiary Brazeau Formation extends to depths of greater than 1000 ft in the Western Alberta High Plains. Intergranular and fracture porosity have a patchy distribution within these clayey and sometimes bentonitic sandstones and mudstones. sometimes bentonitic sandstones and mudstones. The valley floor glaciofluvial and alluvial sand and gravel deposits are the most prospective aquifers of the map area. Groundwater availability and yield potential are dependent on the topographic posi-tion, permeability, saturated thickness, and re-charge characteristics of these deposits. With the exception of the local occurrence of calcium-magnesium sulfate type groundwater in the Front Ranges (which can contain over 2000 ppm total dissolved solids), groundwater quality is excellent throughout the map area, and total dissolved solids contents rarely exceed 500 ppm. (Froehlich-ISWS)

HYDROGEOLOGY OF THE LESSER SLAVE LAKE AREA, ALBERTA,

Research Council of Alberta, Edmonton, R. I. J. Vogwill. Report 77-1, 1978. 32 p, 6 fig, 1 tab, 3 map, 28 ref, 2 append.

Descriptors: *Canada, *Hydrogeology, *Ground-water, *Lakes, Maps, Aquifers, Sands, Gravels, Topography, Mapping, Bedrock, Surface waters, Chemistry, Water chemistry, Rocks, Dissolved solids, Chemical analysis, Geology, Drainage, Vegetation, Forests, Climates, Geomorphology, Land use, Data collections, Climatology, Muskeg, Bogs, Sodium compounds, Calcium compounds, *Alberta(Canada), *Lesser Slave Lake(Canada), *Swan River(Canada), Surficial geology, Hydrochemistry.

The hydrogeology of the Lesser Slave Lake area (NTS 830) was described. Data were unevenly distributed and have been supplemented with field observations and test drilling program during 1974. A large amount of interpretation was involved in the construction of the hydrogeological map and profiles. The most important aquifers in the area are basal or near-basal sands and gravels occurring in prealectal drainage networks. They have been are basal or near-basal sands and gravels occurring in preglacial drainage networks. They have been assigned a 20-year safe yield of 25 to 500 igpm (approximately 2 to 38 1/sec). The most important bedrock aquifers are sandstones and coals of the Wapiti Formation which have been assigned a 20-year safe yield of 5 to 25 igpm (approximately 0.4 to 2 1/sec). Water chemistry is variable, and total dissolved solids contents range from 200 to 2000 to 2 1/sec). Water chemistry is variable, and total dissolved solids contents range from 200 to 2000 ppm in the drift and nonmarine strata. Iron concentrations are usually very high. Groundwaters are generally of the Ca or Na/HCO3+CO3 type with local areas of (1) Ca or Na/SO4 types attributed to high sulfate contents in till, and (2) Na+Ca/Cl types attributed to contamination from deeper marine strata. These deeper marine rocks contain highly saline waters of the Na/Cl type. (Froehlich-ISWS)

ENVIRONMENTAL ISOTOPES IN A STUDY OF THE ORIGIN OF SALINITY OF GROUND-WATER IN THE MEXICALI VALLEY, International Atomic Energy Agency, Vienna

(Austra).

B. R. Payne, L. Quijano, and D. Latorre.

Journal of Hydrology, Vol. 41, No. 3/4, p 201-215,

May 1979. 9 fig, 3 tab, 9 ref.

Descriptors: *Stable isotopes, *Colorado River, *Deuterium, *Oxygen isotopes, *Groundwater, *Mexico, Salinity, Infiltration, Evaporation, Saline waters, Sampling, Isotope studies, Correlation analysis, Surface waters, Connate water, Evapor-

The stable-isotopic and chemical composition of waters in the Mexicali Valley were used to study the origin of salinity of groundwater. It was suggested that the present-day stable-isotopic composition of the Colorado River when it enter the valley is more enriched than three or four decades ago owing to evaporation from the reservoirs which have been constructed on the river during the constructed on the river during ago owing to evaporation from the reservoirs which have been constructed on the river during this period. This has provided distinctive isotopic labels for 'old' and 'recent' Colorado River water. On the basis of the sampling, no evidence was found for the salinity being due to partial mixing with seawater. The dominant salinity control is infiltration from the surface-water system, but evidence also was presented for part of the salinity being due to dissolution of evaporitic deposits. (Visocky-ISWS) W79-08572

ANALYTICAL SOLUTIONS TO THE PROB-LEMS OF TRANSIENT DRAINAGE THROUGH TRAPEZOIDAL EMBANKMENTS WITH DARCIAN AND NON-DARCIAN FLOW, Center for Water Resources Development and Management, Trivandrum (India). P. Basak, and M. R. Madhav. Journal of Hydrology, Vol. 41, No. 1/2, p 49-57, April 1979. 6 fig, 5 ref.

Descriptors: *Dewatering, *Drainage, *Embank-ments, *Theoretical analysis, *Unsteady flow, Equations, Porous media, Darcys law, Drawdown, Flow, Non-Darcy flow, Reservoir drawdown

Under certain simplifying assumptions, three analytical solutions to the problems of transient non-

Darcy drain with a cent The solution The solution cian parame for various results were for Darcian the problem drawdown (Adams-ISV W79-08575)

OCCURRE SATPURA INDIA, Geraghty a V. W. Uhl, Journal of April 1979.

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Evangelica Project pro logically, t lite (weath andstone. sandstone. local and yield, dep depth were type and t flat upland well yields greater that (36.7 1/m) ields in al ield 75 1, tionships to determ graphic lo types. We compared Increment rocks wer rocks by I from basa from the specific c ington we Satpura H W79-0857

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Groundwater-Group 2F

Darcy drainage through trapezoidal embankments with a central impermeable core were presented. The solutions showed the effect of the non-Darcian parameter, n, on the rate of drainage progress for various geometries of the embankments. The results were compared with the known expression for Darcian flow. For Darcian flow, a solution for the problem with inclined central core and partial drawdown also was reported for the first time. (Adams-1SWS) W79-08575

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OCCURRENCE OF GROUNDWATER IN THE SATPURA HILLS REGION OF CENTRAL INDIA, Geraghty and Miller, Inc., Annapolis, MD. V. W. Uhl, Jr. Journal of Hydrology, Vol. 41, No. 1/2, p 123-141, April 1979. 8 fig, 5 tab, 15 ref.

Descriptors: *Groundwater resources, *Groundwater potential, *Washington, Aquifers, Water yield, Weirs, Wells, Hydrology, Specific capacity, Computers, Geology, Groundwater, Rocks, Sandstones, *India, *Well yields, Groundwater development.

tones, "India, "Well yields, Groundwater development."

The Satpura Hills region of central India is characterized by hilly to mountainous terrain, plateaus, and gently undulating country. The recent drilling of over 500 tubewells in the study area by the Evangelical Lutheran Church Water Development Project provided the data base for this study. Geologically, the area is underlain by a zone of saprolite (weathered rocks), crystalline rocks, basalt, and sandstone. Groundwater flow systems are of the local and intermediate type. Well data such as yield, depth, depth of overburden, and aquifer depth were analyzed statistically according to rock type and topography. Wells drilled in valleys and flat uplands were the most productive, and average well yields in the crystalline rocks (90 1/min) were greater than in basalt (65.5 1/min) and sandstone (36.7 1/min). Frequency distributions of well yields in all three rock types are similar; most wells yield 37 1/min or less. Linear and non-linear relationships between well parameters were analyzed to determine factors affecting well yields. Topographic location and fracturing are the predominant factors affecting well yields in all the rock types. Well yield and specific capacity results were compared to results from areas of similar geology. Incremental well yields for wells in crystalline rocks were found to decrease with depth. Similar results were noted in other areas of crystalline rocks were noted in other areas of crystalline rocks were found to decrease with depth. Similar results were noted in other areas of similar geology. Incremental well yields for wells in crystalline rocks were found to decrease with depth. Similar results were noted in other areas of similar geology. Incremental well yields for wells in crystalline rocks were found to decrease with depth. Similar results were noted in other areas of similar geology. Incremental well yields for wells in the State of Washington. It was found that specific capacities for wells in the Satpura Hills region. (L

THE FEASIBILITY OF USING PONDS AS SHALLOW WELLS IN THE GEORGIA COAST-

AL PLAIN,
Georgia Southwestern Coll., Americus. Dept. of
Earth Science.

Earth Science.
B. F. Beck.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-298 635, Price codes: A03 in paper copy, A01 in microfiche. Environmental Resources Center, Georgia Institute of Technology, Atlanta. Technical Completion Report No. ERC-02-79, March 1979. 30 p, 2 fig, 3 tab, 18 ref. OWRT A-079-GA(1).

Descriptors: *Shallow wells, *Ponds, Excavation, Sands, Wells, Water wells, Water supply, Particle size, Permeability, Specific yield, Economic feasibility, Feasibility, Yield equations, Groundwater.

The economic feasibility of using large-diameter, shallow wells in the coastal area of Georgia was investigated. The permeability and specific yield of the aquifer must be known in order to calculate the yield of a well. Permeability and specific yield are related to the distribution of grain sizes; a reliable, predictive equation for these has not yet been

formulated. Samples of medium sand had permeabilities around 400 gpd per sq ft and specific yield was tabulated to be .45; samples of well-sorted, fine sand measured near 10 gpd per sq ft and had a specific yield of .25. Three techniques can be used to calculate the yield of a large-diameter well: the Papadopulos and Cooper (1967) method; the Zdan-kus (1975) method; or by analogy with a collector well using the Hantush (1964) solution. Using real-stic values for permeability and specific yield, as determined for the coastal area of Georgia, a pond requires the following to obtain a yield of 100,000 gpd in medium sand: a 15 foot depth and a radius of 50 feet pumped to a drawdown of four feet. In finer sand the well must be deeper and have a larger radius and drawdown. Costs of excavating a large size pond may be prohibitive; however, near urban areas where fill is needed a pond could be excavated for the value of the materials removed, at no cost to the owner. (Schaefer-IPA) W79-08606

WATER IN MISSOURI, Department of Natural Resources, Jefferson City, MO. Div. of Geology and Land Survey. For primary bibliographic entry see Field 2A. W79-08613

THE SENSITIVITY OF PARAMETERS IN THE PENMAN EVAPORATION EQUATIONS AND DIRECT RECHARGE BALANCE, Birmingham Univ. (England). Dept. of Geological

For primary bibliographic entry see Field 2D. W79-08618

MATHEMATICAL MODEL APPLICATION IN GROUND-WATER STUDIES OF IRAN, Tehran Univ. (Iran). Faculty of Engineering.

F. Ghassemi. Ground Water, Vol. 17, No. 4, p 359-365, July-August 1979. 2 fig, 2 tab, 36 ref.

Descriptors: *Groundwater, *Aquifers, *Model studies, Mathematical models, Analytical techniques, Methodology, Infiltration, Recharge, Natural recharge, Artificial recharge, Transmissivity, Storage coefficient, Pumping, Irrigation, Water resources, Hydrology, *Iran.

Mathematical models of groundwater aquifers with complex geologic and hydrologic factors have been used effectively since 1960. In these models, first the past hydrogeological conditions are simulated, then it is possible to impose on the model the future conditions by increasing redistributed pumping, artificial recharging, or many other factors which may change the existing hydrogeological conditions. Different numerical methods, such as finite differences finite element and dynamic proconditions. Different numerical methods, such as finite difference, finite element, and dynamic programming, are used in mathematical simulation of the aquifers. The study of different aquifers in Iran by classical methods has been started systematically since 1962, and during this period more than 200 aquifers were studied in reconnaissance phase and about 80 aquifers in semi-detailed phase. In 1967, the mathematical model technique was introduced to groundwater researchers of Iran. Actually, 39 aquifers were studied by 2- or 3-dimensional flow models covering nearly 40,000 sq km of Iranian aquifers. In these studies finite difference methods were used, and only a few aquifers were studied by dynamic programming, but the finite element has never been used in Iran. (Sims-ISWS)

MODELLING RAPID FLOW IN AQUIFERS, Birmingham Univ. (England). Dept. of Civil Engi-

neering. K. R. Rushton, and K. S. Rathod. Ground Water, Vol. 17, No. 4, p 351-358, July-August 1979. 9 fig, 1 tab, 5 ref.

Descriptors: *Groundwater movement, *Aquifer characteristics, *Hydrogeology, *Mathematical models, *Unsteady flow, Hydraulics, Springs, Aquifers, Transmissivity, Storage coefficient, Recharge, Limestones, Model studies, *England.

The situation when, due to heavy rainfall, rapid transfer of water occurs in the upper highly permeable region of an unconfined aquifer was examined. The conventional modelling approach of a single transmissivity, which either remains constant or increases with the saturated depth, was shown to be unsatisfactory. Instead, it is necessary to consider the aquifer as consisting of two systems with flow always occurring in the primary system but only entering the secondary system during periods of high recharge. This is necessary because the velocities in the different regions of the aquifer are of significantly different magnitudes. The Lincolnshire Limestone aquifer in England was used as an illustrative example. Initially, a one-dimensional approximation to the aquifer was considered so that the different features of the flow mechanism could be examined in detail. The method of dividing the recharge between the primary and secondary systems was shown to be of great importance. Then, a preliminary two-dimensional model of the whole region was considered. The model response was shown to be of the same form as that observed in the field. (Adams-ISWS)

SPRING DISCHARGE IN RELATION TO RAPID FISSURE FLOW, Anglian Water Authority, Peterborough (Eng-land). Welland and Nene River Div. E. J. Smith.

Ground Water, Vol. 17, No. 4, p 346-350, July-August 1979, 6 fig, 10 ref.

Descriptors: *Groundwater movement, *Aquifer characteristics, *Hydrogeology, *Unsteady flow, *Karst hydrology, Hydraulics, Springs, Aquifers, Transmissivity, Recharge, Limestones, *England.

Rapid fissure flow has been recognized as an important factor in understanding the hydraulic behavior of the Lincolnshire Limestone aquifer of eastern England. A study of the hydrogeology of a Lincolnshire Limestone spring-fed catchment enabled 3 zones of discharge to be defined, based on their relative elevation along the valley floor. Comparison of the discharge characteristics of each zone revealed the existence of rapid groundwater flow associated with a discrete fissure system. Comparison of spring discharges and groundwater storage during a period of 'high', 'low', and 'typical' recharge enabled a conceptual flow model of the aquifer to be constructed. A two-layered model was proposed, in which the secondary zone (lower unit). In addition, there is evidence of a rapid increase in transmissivity with water-table elevation in the secondary zone. The areal distribution of the secondary zone is associated with a network of dry valleys. The spatial distribution of the two zones was explained by geological structure, lithological variations, and the post-glacial history of the area. A two-layered model was developed with these concepts in mind in order to simulate the spring discharges. Once proven, the model can be integrated with the regional hydrogeology and incorporated into existing digital models of the aquifer. (Adams-ISWS) W79-08622

AQUIFER TRANSMISSIVITY FROM SURFI-CIAL ELECTRICAL METHODS, Illinois State Geological Survey, Urbana. For primary bibliographic entry see Field 7C. W79-08623

GROUND-WATER INDUCED CHANGES IN LAKE CHEMISTRY, University of South Florida, Tampa. Dept. of

For primary bibliographic entry see Field 4A. W79-08624

ADVANCES IN GROUNDWATER HYDROLOGY.

Proceedings of Symposium held at Chicago, Illi-nois, 1976. American Water Resources Associ-ation, St. Anthony Falls Hydraulic Laboratory.

Group 2F-Groundwater

Minneapolis, Minnesota, September 1976. 341 p. Saleem, Z. A., editor. Cost \$15.00.

Descriptors: *Groundwater, *Conferences, *Porous media, *Surface-groundwater relationships, *Model studies, Hydrology, Water law, Groundwater recharge, Water management(Applied), Wells, Computer models, management(Applied), Wells, Computer models, Saline water intrusion, Aquifers, Education, Train-ing, Groundwater movement, Aquifer characteris-tics, Water quality, Hydraulics, Flow, Pollutants, Analytical techniques, Numerical analysis, Geo-chemistry, Mathematical models.

The objective of this symposium was to discuss and review advancements in groundwater hydrology. The following aspects of groundwater hydrology were discussed: groundwater law, education, and management; groundwater movement and well hydraulics; salt water intrusion; artificial activities of the salt of recharge and surface water/groundwater relations; aquifer parameter identification; interaction of groundwater with porous media; and computer models. (See W79-08632 thru W79-08656) (Humphreys-ISWS) W79-08631

AN INTRODUCTION TO ADVANCES IN GROUNDWATER HYDROLOGY, Illinois Univ. at Chicago Circle. Dept. of Geologi-

cal Sciences. Z. A. Saleem.

Z. A. Saleem.

In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minnespolis, Minnesota, p 2-6, September 1976. 33 ref.

Descriptors: *Groundwater, *Education, *Institu-tions, *Reviews, *United Nations, *United States, Publications, Research priorities, Governments,

Advances in groundwater science and technology in response to the growing demand for ground-water in recent years have been astonishing due to many reasons including: the intensive efforts of the national and international organizations concerned with surface and groundwater resources; active roles of the Congress and the Federal and State governments; and the impact of modern science governments; and the impact of modern science and technology. Advances have been made in all aspects of groundwater hydrology including: un-derstanding of complex groundwater systems; techniques and capabilities for analyses of complex problems and solutions of several complex prob-lems; the quality and quantity of data concerning groundwater resources and the storage and retriev-al of data; the rise in the quality and quantity of groundwater resources and the storage and retriev-al of data; the rise in the quality and quantity of educational opportunities and publications related to groundwater hydrology; and the overall aware-ness of the significance of groundwater as a slowly renewable natural resource. However, there still renewable natural resource. However, there still are many areas where improvements and greater advances can be made. Advances must be made in better understanding of interactions of groundwaters with subsurface environments. The physico-chemical responses of aquifer systems to a variety of natural and artificial stresses need to be further investigated, for example, stresses due to heat storage well systems and due to the underground pumped hydro-storage systems. The long-range regional adverse effects of stresses on groundwaters and on the subsurface environments need to be further investigated. Policies for the long range optimal conjunctive use of surface and groundwater resources of regional areas should be determined. There is definite need for better data so as to refine predictions of effects on the extrac-tion of groundwaters and of the use of subsurface environment for liquid waste disposal and for other purposes. (See also W79-08631) (Humphreys-ISWS) W79-08632

PROGRESS IN RESEARCH ON WELL HY-

DRAULICS, Rice Univ., Houston, TX. Dept. of Geology.

In: Advances in Groundwater Hydrology; Pro-ceedings of Symposium held at Chicago, Illinois,

1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapo-lis, Minnesota, p 15-28, September 1976. 103 ref.

Descriptors: *Wells, *Hydraulics, *Aquifers, *Mathematical models, Model studies, Underflow, Steady flow, Unsteady flow, Groundwater movement, Theoretical analysis, Analytical techniques, Reviews, Flow, Equations, Aquifer characteristics,

Exploration and development of underground natural resources are closely associated with advances in well hydraulics. Much of the recent research has been concentrated on improving the understanding of the phenomenon of fluid flow towards a pumping well. Detailed theoretical studies have been undertaken for the flow in all the basic reservoir formations: confined, unconfined, leaky, aquiferaquitard, and fractured, with account being taken of the compressibility and anisotropy of the aquifer, the partial penetration of the abstraction well, well-bore storage, the depth at which the drawdown in an observation well is measured, and the saturated and unsaturated zones above the drawdown in an observation well is measured, and the saturated and unsaturated zones above the water table. Advances in computer technology have facilitated solutions using highly sophisticated analytical methods, application of which will enlarge the scope in planning and development of the well fields. Though the present review emphasized the recent advances in well hydraulics, the earlier work was also included where needed to provide work was also included where needed to provide the necessary background. Some general differen-tial equations for the underground flow and the main assumptions were given to retrace the general approach in well hydraulics study. Consideration was mainly concerned with the unsteady state flow developments. (See also W79-08631) (Humphreys-ISWS) W79-08634

A REVIEW OF THE INTEGRODIFFERENTIAL A REVIEW OF HE INITERIOR TERESTITAL
EQUATIONS APPROACH TO LEAKY
AQUIFER MECHANICS,
Universidad Nacional Autonoma de Mexico,
Mexico City. Inst. of Applied Mathematics.

I. Herrera.

I. Herrera.
In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 29-47, September 1976. 5 fig, 1 tab, 15 ref.

Descriptors: *Aquifers, *Groundwater, *Mathematical models, *Theoretical analysis, Model studies, Reviews, Analytical techniques, Flow Groundwater movement, Equations, Hydraulics, Drawdown, Numerical analysis, Leaky aquifers.

The integrodifferential equations approach to leaky aquifer mechanics has been developed as part of a program of research which is being carried out at the National University of Mexico. In this paper, a review of this theory in its present state of development was presented. First, the integrodifferential equations formulation was presented. ferential equations formulation was given. Then, approximate theories were derived by developing approximations of the memory and influence functions. A critical discussion of these theories was tions. A critical discussion of these theories was included, from the point of view of its adequacy for numerical treatment. An exact numerical method was presented, and its advantages over standard methods were exhibited. An application of the integrodifferential equations to carry out error analysis was also explained. (See also W79-08631) (Humphreys-ISWS)

ADVANCES AND UNCERTAINTIES IN THE STUDY OF GROUNDWATER FLOW IN FIS-SURED ROCKS.

Rice Univ., Houston, TX. Dept. of Geology.

T. D. Streltsova.

In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago. Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 48-56, September 1976. 51 ref.

Descriptors: *Groundwater, *Fissures(Geologic), *Flow, *Model studies, Fracture permeability,

Risks, Fractures(Geologic), Reviews, Mathematical models, Analytical techniques, Porous media, Groundwater movement, Unsteady flow, Drawdown, Pumping, Porosity, Permeability, Fissured

Analytical attempts to take account of the effect of Analytical attempts to take account of the effect of fracturing are associated with representation of the fissured rock masses by models to which a continuity approach may be applied. Two such basic conceptual models were considered. The first one represents so-called 'double-porosity' media, conrepresents so-called 'double-porosity' media, consisting of block masses of primary porosity separated from each other by many randomly distributed and oriented fissures. The second model represents a porous medium containing aligned flat fissures of high permeability extending horizontally, with an additional possible system of vertical fractures. Discussion on developments of these models and their relation was given. The behavior of the fluid flow in response to a pressure change due to pumping is characterized for the two constituents of a fractured formation: fissures and porous block. pumping is characterized for the two constituents of a fractured formation: fissures and porous blocks. The fissure and the porous block draw-downs were discussed for the cases when compressibility, transmissibility, and relative sizes of both the porous blocks and their adjoining fissures are taken into account. Vertical and horizontal flow taken into account. Vertical and horizontal flow components are assumed in a fissure as well as in a block. The fissure-porous block flow exchange was shown to have a change of sign across the fissure-block boundary with the effect that in a certain region adjacent to the pumped well the water head recordings will indicate an initial increase of the water pressure in response to pumping. The behav-ior of an unconfined fissured aquifer was also dis-cussed. Determination of the geometry and hyior of an unconfined fissured aquifer was also uncussed. Determination of the geometry and hydraulic properties of a fractured formation constants for a fractured aquifer, and development of methods for the analysis of suppring test data are the objectives of sis of pumping test data are the objectives of further study. (See also W79-08631) (Humphreys-ISWS) W79-08636

STOCHASTIC ANALYSIS OF FLOW AQUIFERS,

New Mexico Inst. of Mining and Technology,

New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
L. W. Gelhar.
In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 57-71, September 1976. 11 fig, 10 ref

Descriptors: *Aquifer systems, *Groundwater movement, *Model studies, *Stochastic processes, Flow, Mathematical models, Analytical techniques, Synthetic hydrology, Variability, Spatial distribution, Dispersion, Statistical methods, Water levels, Hydraulic conductivity, Aquifer characteristics, Groundwater recharge, Natural recharge, Water table.

Although groundwater flow has traditionally been modeled in a deterministic sense, the perspective of stochastic processes is becoming more widely adopted to describe the phenomenon. Recent work was summarized in which this approach has been was summarized in which this approach has been used to characterize the temporal variability which, for example, is associated with natural recharge, and the spatial variability, introduced because of the permeability structure of natural deposits. Time series analysis of groundwater levels and precipitation illustrate the filtering effect of groundwater systems. The use of frequency spectra and transfer functions to estimate aquifer parameters was illustrated, and current work using similer techniques for estimate aroundwater resimilar techniques to estimate groundwater re-charge was described. Field data demonstrated that hydraulic conductivity varies from point to point in aquifers. Several continuum analyses of spatial flow effects were summarized, based on spectral analysis in the wave number domain. Ap-plications to flow network design and dispersive pilcations to now network design and dispersive mixing analysis were discussed. The results showed that the effect of multidimensional flow perturbations is significant. (See also W79-08631) (Humphreys-ISWS) W79-08637 A SYSTEM DURE FOR MOGENEO California U ing Systems W. W-G. Y In: Advance ceedings of 1976. Amer Anthony F lis, Minneso

Descriptors water, *H water, *H Aquifers, Model st Groundwardistribution

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was based variations tempts to geneous su ation proc known pa subregions identify w or ill-deter ance. Subo determine around the tion. Nur demonstra cially for aquifer sy data, the p tion of ar squares er are determ parameter The meth the geom known. (S W79-0863

THE AN Arizona 1 Water Re S. P. Neu In: Adva ceedings 1976. Am lis, Minne ref.

Descripto ematical analysis, Risks, Fi ation, Li ming, Inv

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Groundwater-Group 2F

A SYSTEMATIC OPTIMIZATION PROCE-DURE FOR THE IDENTIFICATION OF INHO-MOGENEOUS AQUIFER PARAMETERS, California Univ., Los Angeles. Dept. of Engineer-

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spersive results nal flow 9-08631) mg Systems.
W. W-G. Yeh, and Y. S. Yoon.
In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 72-82, September 1976. 3 tab, 22

Descriptors: *Aquifer characteristics, *Ground-water, *Heterogeneity, *Mathematical models, Aquifers, Analytical techniques, Optimization, Model studies, Variability, Unsteady flow, Groundwater movement, Transmissivity, Spatial distribution, Statistical methods.

this paper developed a systematic optimization procedure for parameter identification in an inhomogeneous aquifer system. The parameters to be identified are the transmissivities, and identification was based upon scattered observations of head variations within the system. The procedure attempts to improve the method of subdividing a given inhomogeneous system into piecewise homogeneous subregions. Each subregion is characterized by a single parameter. During the optimization process, the covariance matrix of the unknown parameters associated with each of the subregions is estimated and used as a measure to identify whether parameters are well-determined or ill-determined. An ill-determined parameter is characterized by the estimate having a large variance. Subdividing is refined only around the well-determined parameters, while coarse grids are used around the ill-determined parameters. A constrained least-squares method is used for optimization. Numerical examples were carried out which demonstrates the validity of the procedure, especially for predictional purposes. For a given aquifer system with given quantity and quality of data, the proposed method enables the determination of an optimum trade-off between the least-squares error and system characterization. The dimension and configuration of the parameter space are determined based upon whether the estimated parameters are well-determined or ill-determined. The method developed is extremely useful when the geometric subdivisions of parameters are unknown. (See also W79-08631) (Humphreys-ISWS) W79-08638

THE AM-FM CONCEPT IN PARAMETER IDENTIFICATION,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman, and U. Kafri.
In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 83-101, September 1976. 5 fig, 12 ref.

Descriptors: *Groundwater movement, *Mathematical models, *Groundwater, *Theoretical analysis, Model studies, Analytical techniques, Risks, Finite element analysis, Mathematical studies, Water levels, Water table, Aquifers, Optimization, Linear programming, Quadratic programming, Inverse problem.

A theoretical analysis of the inverse problem asso-ciated with the Boussinesq equation of ground-water flow indicated that the solution to this probwater flow indicated that the solution to this prob-lem is often non-unique and unstable. In particular, low-amplitude errors in the data may cause severe spatial osciallations in the parameters of the model, thereby making it impossible to solve the inverse problem by classical mathematical methods. In order to obtain a meaningful solution, it is neces-sary to control (or modulate) the frequency and amplitude of these oscillations in a systematic manner. This can be accomplished by defining appropriate 'regularization' criteria and then gradually varying their magnitude with the aid of parametric linear and quadratic programming or by other techniques. The degree to which the parameters must be regularized by modulating

their frequency and amplitude reflects the degree of resolution that can be achieved with a given set of data. Previously published theoretical examples together with recent preliminary results from the Cienega Basin near Tucson, Arizona, indicated that the AM-FM concept is highly promising. (See also W79-08631) (Humphreys-ISWS) W79-08639

ADVANCES IN GROUNDWATER FLOW MOD-ELING, Illinois State Water Survey, Urbana. T. A. Prickett. In: Advances in Groundwater Hydrology; Pro-ceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapo-lis, Minnesota, p 102-112, September 1976. 52 ref.

Descriptors: "Groundwater movement, "Model studies, "Computers, "Reviews, "Groundwater, Hydraulic models, Mathematical models, Flow, Computer models, Analog models, Research and development, Finite element analysis, Analytical techniques, Finite difference models.

techniques, Finite difference models.

An outline of groundwater 'flow' modeling techniques was given. This contrasts with groundwater 'transport' modeling which is reported elsewhere at this symposium. A brief background of each technique within the categories of mathematical, sand tank, analog, and numerical models was given. Special emphasis was given to techniques developed since 1970. Further attention was given to the set of references cited in that they each contain the three elements of theory, documented model descriptions or computer codes, and practical applications. The report concluded with a brief description of available computer equipment and its implication on future model development. It is the author's opinion that the advance realized in groundwater modeling since 1970 has been mainly due the world-wide availability of digital computers. The number of computer centers is large. However, the trend seems to be from the central computer facility to the decentralized type of operation. Remote terminal operation by ordinary telephone line is commonplace, the relatively low cost minicomputer is becoming a reality, and the microprocessor, in the form of hand-held types, is now becoming reasonable in price. This is leading to more advances in numerical techniques for groundwater flow modeling, especially for small computer systems. (See also W79-08631) (Humphreys-15WS)
W79-08640

NUMERICAL SIMULATION OF CONTAMINANT TRANSPORT IN SUBSURFACE SYSTEMS,

California Univ., Davis. Dept. of Land, Air and Water Resources.

For primary bibliographic entry see Field 5B.

W79-08641

THE FINITE ELEMENT METHOD IN GROUNDWATER TRANSPORT, Princeton Univ., NJ. Dept. of Civil Engineering. For primary bibliographic entry see Field 5B. W79-08642

DISPERSION IN NON-UNIFORM AND ANI-SOTROPIC POROUS MEDIA, Shell Development Co., Houston, TX. M. B. Moranville, D. P. Kessler, and R. A.

Greenkorn.

Greenkorn.

In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 173-186, September 1976. 4 fig, 1 to 28 cf.

Descriptors: *Groundwater movement, *Mathematical models, *Reviews, *Porous media, Stochastic processes, Model studies, Flow, Dispersion, Permeability, Diffusion, Aquifers, Statistical models, Anisotropy, Continuum models, Phenomenological models.

This paper reviewed continuum models, statistical models, and phenomenological models for the description of flow in porous media. Both permeability and dispersion were treated. The effect of non-tropy on dispersion and the effect of anisotropy on dispersion were both specifically treated using a stochastic model based on a random ensemble of idealized pores distributed according to some joint probability density function. For a homogeneous medium, the dispersion tensor was calculated in terms of single step averages, and then this form was considered for particular probability density distributions—specifically, delta functions, uniform distributions, and exponential distributions. Results were compared with laboratory measurements in unconsolidated media. (See also W79-08631) (Humphreys-ISWS)

DESIGNING A MODEL FOR DEEP-LYING PORE FLUIDS, Illinois Univ. at Urbana-Champaign. Dept. of Ge-

ology.

D. L. Graf, and D. E. Anderson.
In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p. 187-198, September 1976. 32 ref, 1 append. NSF GA-21156, GAR 76-13565.

Descriptors: *Porous media, *Flow, *Thermodynamic behavior, *Geophysics, Entropy, Heat flow, Diffusion, Thermodynamics, Groundwater, Osmosis, Geothermal studies.

sis, Geothermal studies.

The accumulated experience of groundwater hydrologists in modeling fluid flow through porous media is finding new application in studies of petroleum migration, ore deposition, and geothermal power development at depths where the pore fluids are hot and highly saline. Chemical reactions, heat flow, diffusion of dissolved substances, and the osmotic phenomena associated with cross-formational transport through shales will often be more important in this environment than the flow of bulk flow fluid laterally through a particular formation. Nonequilibrium thermodynamics is attractive for treating these complex systems because of its theoretical breadth, and because the entropy production and entropy balance equations developed in this approach make it possible to tell whether a given system is moving toward an equilibrium state or a steady state with time. The assumption of linearity between thermodynamic forces and fluxes required in classical nonequilibrium thermodynamics is moderately in error for diffusion coefficients, which are concentration-dependent in these brines, and is in considerable elifficulty for chemical reactions, which typically proceed far enough from equilibrium to be outside the region of linear behavior. A more general nonlinear model is being sought by workers in continuum mechanics, engineering transport studies, and nonequilibrium thermodynamics. (See also W79-08631) (Humphreys-ISWS)

IDENTIFICATION OF GEOCHEMICAL PAT-TERNS IN GROUNDWATER BY NUMERICAL ANALYSIS, Suwannee River Water Management District, White Springs, FL. For primary bibliographic entry see Field 5B. W79-08647

MIGRATION OF LANDFILL LEACHATE THROUGH UNCONSOLIDATED POROUS

MEDIA,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 5B.
W79-08648

THEORETICAL DEVELOPMENTS AND PRACTICAL NEEDS IN THE FIELD OF SALT WATER INTRUSION, North Carolina State Univ. at Raleigh. Dept. of

Civil Engineering.
For primary bibliographic entry see Field 5B.

Group 2F-Groundwater

W79-08649

RELATIONSHIPS BETWEEN SMALL WATER BODIES AND GROUNDWATER, New Hampshire Univ., Durham. Inst. of Natural and Environmental Resources. For primary bibliographic entry see Field 2A. W79-08650

REPRESENTING STREAM AQUIFER INTER-

ACTION, Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.

W. E. Kelly. W. E. Kelly.
In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 262-270, September 1976. 6 fig, 15

Descriptors: *Surface-groundwater relationships, *Streams, *Groundwater movement, *Aquifer systems, Analytical techniques, Analysis, Model studies, Analog models, Mathematical models, Pumping, Water wells, Groundwater, Theoretical analy-

A comparison of theoretical solutions for the re-sponse of infinite and semi-infinite homogeneous aquifers with fully penetrating streams suggested aquiters with fully penetrating streams suggested that, at any point, the response to a step change in stream stage may be used to predict the rate of stream depletion due to a step change in pumping rate at the same point. This was tested on an idealized stream-aquifer system and digital and analog models of an actual stream-aquifer system. Results demonstrated that rates of stream depletion due to pumping may be determined rayfully in due to pumping may be determined rapidly in digital and analog models by determining the aquifer response to stream stage changes. (See also W79-08631) (Humphreys-ISWS)

INTERTEMPORAL CONTROL OF GROUND-WATER IN MULTIAQUIFER MODELS, Montana State Univ., Bozeman. Dept. of Agricultural Economics and Economics.

For primary bibliographic entry see Field 6A. W79-08653

A MANAGEMENT MODEL FOR DETERMIN-ING EFFLUENT STANDARDS FOR THE ARTI-FICIAL RECHARGE OF MUNICIPAL AND IN-DUSTRIAL WASTEWATERS,

Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering. For primary bibliographic entry see Field 5E. W79-08654

STOCHASTIC MANAGEMENT OF A STREAM-AQUIFER SYSTEM,

Universidad Nacional Automona de Mexico, Mexico City. Inst. de Geofisica. For primary bibliographic entry see Field 6A. W79-08655

FLOW TO WATER-TABLE WELLS DERIVING THEIR DISCHARGE FROM CAPTURE, Geological Survey, Reston, VA. Water Resources

For primary bibliographic entry see Field 6A. W79-08656

MAP SHOWING GROUND-WATER CONDITIONS IN THE KAIBITO AND TUBA CITY AREAS, COCONINO AND NAVAJO COUNTIES, ARIZONA-1978,

Geological Survey, Tucson, AZ. Water Resources

For primary bibliographic entry see Field 7C. W79-08688

MAP SHOWING GROUND-WATER CONDITIONS IN THE VIRGIN RIVER, GRAND

WASH, AND SHIVWITS AREAS, MOHAVE COUNTY, ARIZONA--1976, Geological Survey, Tucson, AZ. Water Resources

For primary bibliographic entry see Field 7C. W79-08689

WATER RESOURCES OF THE SANTA YNEZ INDIAN RESERVATION, SANTA BARBARA COUNTY, CALIFORNIA, Geological Survey, Menio Park, CA. Water Re-

ources Div. For primary bibliographic entry see Field 4B. W79-08698

2G. Water In Soils

STATISTICAL RELATIONSHIPS OF WATER FLOW PARAMETERS WITH SOIL MATRIX AND POROSITY PROPERTIES,

Indian Agricultural Research Inst., New Delhi. Div. of Agricultural Physics. V. Murali, G. S. R. Krishna Murti, and A. K.

Sinha.

Journal of Hydrology, Vol. 41, No. 3/4, p 371-376, May 1979. 4 tab, 9 ref.

Descriptors: *Soil water movement, *Statistical models, *Unsaturated flow, *Hydraulic conductivity, *Porosity, Correlation analysis, Soil properties, Iron oxides, Soil texture, Organic matter, Pores, Model studies, *India, Pore size distribution.

Relationships of the water flow parameters with two sets of soil characteristics were analysed statistically for 20 soils of India. Hydraulic conductivity and soil water diffusivity at different moisture levels covering a wide range of field moisture regime were found to be strongly influenced by the matrix properties-texture, organic matter, free iron oxide-and by the pore size distribution of the soils. (Visocky-ISWS)
W79-08364

PORE SIZE DISTRIBUTION-A FACTOR TO BE CONSIDERED IN INFILTRATION STUD-TES.

University Coll., London (England). Dept. of Geography. S. W. Baker.

Journal of Hydrology, Vol. 41, No. 3/4, p 279-290, May 1979. 2 fig, 2 tab, 17 ref.

*Infiltration, *Size, Descriptors: *Pores, *Infiltration, *Size, *Soil properties, *Distribution, Interstices, Hydraulic conductivity, Soil moisture, Capillary action, Model studies, Anelids, Statistical methods, Cor-relation analysis, Infiltrometers, Colloids, Path analysis, Swelling, Clay content.

Pore size distribution (PSD) is often mentioned as Pore size distribution (PSD) is often mentioned as an important factor controlling the rate of infiltration into a soil, but surprisingly when it comes to quantitative assessment or prediction of infiltration rates, PSD is rarely considered. Four possible reasons were suggested to explain this paradox: (1) the difficulties of isolating PSD from the entanglement of variables that control infiltration rates; (2) the variability of PSD through time; (3) measurement problems; and (4) the difficulty of expressing PSD as a single-term index which is suitable for any subsequent analysis. An attempt was made to con struct a suitable index of pore size distribution, and then to include this in a path analysis study to examine the variable structure between infiltration, PSD, and a number of additional explanatory variables. (Visocky-ISWS) W79-08569

SIMULTANEOUS TRANSPORT OF WATER AND REACTING SOLUTES THROUGH MULTILAYERED SOILS UNDER TRANSIENT UNSATURATED FLOW CONDITIONS,

Argonne National Lab., IL. Div. of Environmental Impact Studies.

A. B. Gureghian, D. S. Ward, and R. W. Cleary. Journal of Hydrology, Vol. 41, No. 3/4, p 253-278, May 1979. 17 fig, 1 tab, 45 ref. EPA P-002103-01-0.

Descriptors: *Ion transport, *Dispersion, *Soil water movement, *Unsaturated flow, Unsteady flow, Solutes, Numerical analysis, Computer models, Fertilizers, Ammonium compounds, Chemical reactions, Inflitration, Evaporation, Soil properties, Hydraulic properties, Mass transfer, Equations, Nitrification, Adsorption, Hydraulic conductivity, Model studies, *Multilayered soils, Finite-difference methods, Mass transport.

one-dimensional, unsteady-state numerical model for the simultaneous movement of water and multisolutes through multilayered soil systems under unsaturated flow conditions was presented. The multilayered system was represented as a series of homogeneous layers, and a two-step implicit finite-difference method was used to solve the resulting set of flow equations. The solute equation was solved by the Crank-Nicolson method. For illustrative purposes, one of the multi-solute systems considered was an ammoniacal agricultural fertilization problem in which the sequential chemical reaction of ammonium going to nitrite, going to nitrate was described by first-order kinetics with linear adsorption isotherm was used to illustrate the effects of single solute adsorption in a multilayer sequence. Of considerable interest to those involved in the disposal of wastes on land is the effect of the layering sequence (coarse-finemodel for the simultaneous movement of water is the effect of the layering sequence (coarse-fine-coarse vs. fine-coarse-fine) on the final outlet concontration. The pressure based model considers both infiltration, redistribution and evaporation. Cubic spline functions are used to define the soil hydraulic properties. (Visocky-ISWS) W79-08570

HYDROLOGICAL APPLICATIONS OF NOBLE GASES AND TEMPERATURE MEASUREMENTS IN UNDERGROUND WATER SYSTEMS: EXAMPLES FROM ISRAEL,

NEWS: EXAMPLES FROM ISRAEL, Weizmann Inst. of Science, Rehovot (Israel). O. Herzberg, and E. Mazor. Journal of Hydrology, Vol. 41, No. 3/4, p 217-231, May 1979. 5 fig, 8 tab, 9 ref.

Descriptors: *Argon, *Groundwater, *Hydrologic cycle, *Geothermal studies, *Tracers, Gases, Temperature, Springs, Karst, Recharge, Saturated flow, Circulation, Aquifers, *Noble gases, *Israel, Krypton, Xenon, Paleotemperature.

The observations on the behavior of the noble Ine observations on the behavior of the noble gases in the hydrological cycle may provide the tools to calculate the initial noble-gas contents in recharging water. This is essential for: (1) the use of the noble gases as tracers in geothermal systems; and (2) the evaluation of initial noble-gas contents and (2) the evaluation of initial noble-gas contents in ancient waters for paleotemperature studies. Noble-gas contents in four non-karstic and three karstic springs were repeatedly measured, along with the temperatures in the recharge and discharge points. The Ar, Kr, and Xe contents in non-karstic springs were found to reflect the temperature of the base of the aerated zone above the water table. This temperature was seen to be close to the local autorage annual temperature and different parts of the second contents. to the local average annual temperature and different from the rainy season temperature. The difference between the temperature measured at a spring and the noble-gas-deduced temperature indicates the depth of circulation in the saturated aquifer, area (e.g., local rain or recharge from adjacent mountains). Karstic springs were found to contain substantial air excesses, revealing a negative corre-lation to discharge. (Visocky-ISWS) W79-08571

SOME OBSERVATIONS ON THE PERIODIC VARIATIONS OF MOISTURE IN STABILISED AND UNSTABILISED SAND DUNES OF THE INDIAN DESERT.

Central Arid Zone Research Inst., Jodhpur (India).

J. P. Gupta. Journal of Hydrology, Vol. 41, No. 1/2, p 153-156. April 1979. 1 fig, 1 tab, 3 ref.

Descriptors: *Soil moisture, *Dune sands, *Deserts, Moisture uptake, Hydrology, Rainfall, Dunes, Foreign countries, Foreign research, Trees. Grasses, Particle size, *India, Moisture profile.

During 19 studied in the Bikane stabilized served du dry season an average compared this time storage in 70 mm, w 12 to 23 m W79-0857

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Lakes-Group 2H

During 1974-1976, the dynamics of moisture was studied in stabilized and unstabilized sand dunes of the Bikaner region. Maximum moisture in both the stabilized and unstabilized sand dunes was observed during the rainy season. At the end of the dry season, during the period of peak evaporation, ie. June, the unstabilized sand dunes still contained an average of 2-5% moisture at 30-180 cm depth compared to 1% or less in the stabilized dunes. At this time of the year, the total profile moisture storage in the unstabilized dunes varied from 50 to 70 mm, while in the stabilized dunes it ranged from 12 to 23 mm. (Lee-ISWS)

THE SENSITIVITY OF PARAMETERS IN THE PENMAN EVAPORATION EQUATIONS AND DIRECT RECHARGE BALANCE, Birmingham Univ. (England). Dept. of Geological Sciences.

For primary bibliographic entry see Field 2D. W79-08618

COMPARISON OF DIFFERENT METHODS FOR MEASURING SOIL SALINITY UNDER FIELD CONDITIONS, Indian Agricultural Research Inst., New Delhi. Water Technology Center. For primary bibliographic entry see Field 7B. W79-08757

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THE SUMMER CONDITION OF THREE EASTERN TRANSVAAL RESERVOIRS AND SOME CONSIDERATIONS REGARDING THE ASSESSMENT OF TROPHIC STATUS, National Inst. for Water Research, Pretoria (South

Africa).

R. D. Walmsley, and D. F. Toerien.

Journal of the Limnological Society of South
Africa, Vol. 3, No. 2, p 37-41, 1977. 4 fig, 2 tab, 18

Descriptors: *Reservoirs, *Trophic level, Aquatic algae, Aquatic habitats, Hypolimnion, Limnology, Reservoir stages, Da Gama Reservoir, Klipkopje Reservoir, Witklip Reservoir, Chemical properties, Aquatic environment, Light penetration, Chlorophyll a, Mesotrophy, Eutrophication, South Africa.

Africa.

Limnological data on the late summer conditions of the Da Gama, Klipkopje, and Witklip reservoirs is given and discussed. Temperature and oxygen profiles, light penetration characteristics, chlorophyll a content, and algal growth potential (AGP), were determined for each reservoir. Water samples from different depths were analyzed for various chemicals and properties. The water column showed distinct layering. Secchi disc transparency appeared to be at a depth of about 5-10% of the light intensity of the surface. Chemical analyses showed waters from all three reservoirs to be acidic. Bottom waters had lower pH values than surface waters; conductivity and alkalinity values were much higher at the bottom. AGP increased with depth of the sample for all three reservoirs. Nitrogen was shown to be the growth limiting factor for some algae in all three reservoirs. In all, chlorophyll a concentrations showed that phytoplankton populations were not unduly high. Transparency in the three may be regulated by chlorophyll a context, rather than by quantities of suspended clay as in other South African reservoirs. Temperature stratification was not classical for this type of water body. The waters of the three may be classified as soft acidic waters. Stratification was stable and typical of a eutrophic condition. The three reservoirs can be tentatively classified as mesotrophic. (Schaefer-IPA)

LAKE MCILWAINE AFTER TWENTY-FIVE YEARS,
Department of National Parks and Wild Life Man-

agement, Salisbury (Rhodesia). B. E. Marshall.

Rhodesia Science News, Vol. 12, No. 3, p 79-82, March 1978, 5 fig.

Descriptors: *Lake morphology, Water pollution, Lake McIlwaine, Rhodesia, Artificial lakes, Lim-nology, Lake sediments, Recreation facilities, Lakes, Eutrophication, Aquatic algae, Nuisance algae, Nutrients, Fish.

algae, Nutrients, Fish.

Lake McIlwaine, a man-made lake created in 1952 with a surface area of 2630 ha is examined. It is the first African Lake to experience artificial eutrophication, a feature associated with lakes in industrialized northern countries. Serious algal blooms first appeared in 1960. The situation has become increasingly severe, but diversion of sewage effluent to irrigation of land has caused a decline in the nutrient level. The lake waters are thermally stratified. In the summer, large quantities of nutrient are trapped in the anaerobic bottom waters; the lake becomes isothermal in the winter and trapped nutrients are released and stimulate algal growth. The phytoplankton consists almost entirely of bluegreen algae. Tilapia and algae blooms may have inhibited macrophytes. Benthic fauna are important as consumers of organic sediments and as fish food. Only seven of the 25 species of fish occurring in the lake are important commercially or for angling. Total fish production is about 250-300 tonnes/yr. Inorganic pollution is not yet a serious problem, but should be closely watched. (Schaefer-IPA)

WATER EUTROFICATION-A 20TH CENTURY PROBLEM (PART II), National Inst. for Water Research, Pretoria (South

J. Hemens. Chemsa, Vol. 3, No. 12, p 201-203, December 1977. 1 fig, 4 ref.

Descriptors: *Eutrophication, *Nutrient removal, *Phosphorus, South Africa, Water properties, Nurients, Lakes, Dams, Fertility, Biocontrol, Toxins, Water quality control, Water treatment, Harvest-

The physical, chemical, and biological methods that have been used to reduce or prevent eutrophication are described. Probably the most effective, and hence most desirable long term approach is to control the influx of nutrients of a lake. Most nutrient limitation programs have been concerned with the limitation of phosphorus since it is most often the critical nutrient. The time required to organize and implement this approach may be lengthy so other quicker methods which accelerate nutrient outflow or prevent internal recycling are used, even though they usually provide only temporary relief. In-lake control methods seek to manipulate the sediment in various ways because of the important role of sediments. Dredging, dilution or flushing, selective discharge, nutrient precipitation and inactivation, harvesting the plant or fish production of lakes and dams, and use of algicides and herbicides are possible approaches to reducing nutrient concentrations. Almost all methods involve considerable effort and expense. There is no effluent standard for phosphorus in South Africa; consideration is now being given to the need for one. Addition of metal ions at a suitable stage in sewage treatment plants and microbiological activity to incorporate phosphorus into cell tissue are one. Adultion of metal ions at a suitable stage in sewage treatment plants and microbiological activ-ity to incorporate phosphorus into cell tissue are being examined as methods of phosphorus removal in South Africa. (Schaefer-IPA) W79-08508

THE LIMNOLOGY OF SOME SOUTH AFRICAN IMPOUNDMENTS, PART I: THE PHYSICO-CHEMICAL LIMNOLOGY OF HART-BEESPOORT DAM, National Inst. for Water Research, Pretoria (South

National Africa).
W. E. Scott, M. T. Seaman, A. D. Connell, S. I.
Kohlmeyer, and D. F. Toerien.
Journal of the Limnological Society of South
Africa, Vol. 3, No. 2, p 43-58, 1977. 27 fig, 23 tab,

Descriptors: *Hartbeespoort Dam, *Physicochemical properties, Limnology, Hypolimnion, Limno-

9

logy, Lakes, South Africa, Impoundments, Aquatic environment, Eutrophication, Oligotrophy, Water properties, Chemical analysis, Nutrients, Nitrogen, Phosphorus, Turnovers.

Comparison of recently-obtained physico-chemical limnological data and results of earlier studies indicate changes accompanying the metamorphosis of the Hartbeespoort Dam from oligotrophic to eutrophic condition. Water transparency, temperature, oxygen concentrations, and pH were determined in situ. Chemical analyses, conductivity studies, algal bioassays, and identification of growth limiting nutrients were carried out in the laboratory. Statistical analyses evaluated differences in concentrations of chemicals at sampling stations. Results obtained regarding the volume of water in the dam, the light regime, temperature studies, including the volume of water in the dam, the light regime, temperature studies, including stotherms for the six sampling stations and oxygen isopheths for the sampling stations are given. The concentrations of ammonia nitrogen, nitrate nitrogen, nitrite nitrogen, organic nitrogen, total nitrogen, orthophosphate phosphorus, total phosphorus, sodium, silica, potassium, calcium, magnesium, chloride, and sulphate are detailed. Alkalinity, chemical oxygen demand, methylene-blue active substances, and algal growth potential are discussed. The lake was shown to be warm, monomictic, and alkaline with high levels of nitrogen and phosphorus. Overturn is in April. The pH and mineral content have increased over the last 50 years; phosphate concentrations have increased about one hundred fold during that period. (Schaefer-IPA)

INSTITUTE FOR FRESHWATER STUDIES, RHODES UNIVERSITY. Scientiae, Vol. 18, No. 4, p 35-37, October-December 1977. 3 fig.

Descriptors: *Lake Sibaya, *Lake Swartvlei, *Lake morphology, South Africa, Lakes, Aquatic habitats, Balance of nature, Limnology, Ecology, Hydrobiology, Cycles.

Studies conducted by the Institute for Freshwater Studies at Rhodes University on the ecological structure of South Africa's coastal lakes are discussed. The lakes were formed during the last great northern hemisphere glaciation in the Pleistocene era about 25,000 years ago. Faunal elements commonly found in South African estuaries today provide a clue to the estuarine origin of these lakes. Investigations suggest that cycles of elevated salinity are naturally occurring aperiodic or irregular cycles caused by such factors as fluctuations of rainfall and inflow into the lake, and not necessarily by man's activities. The pattern of interactions between the main plant and animal components of a lake can be sorted out due to the relative simplicity of the ecological structure of the lakes, and in a lake can be sorted out due to the relative simplicity of the ecological structure of the lakes, and in particular, Lake Sibaya. At Lake Sibaya, the importance of the extensive shallow terrace to the growth and reproduction of the cichlid fish Sarotherodon mossambicus was studied. At Lake Swartvlei, hydrobiological studies centered mainly on the structure of rooted water plant communities and their role in the hydrochemical processes in and their role in the hydrochemical processes in the lake, particularly the uptake and translocation of phosphorus. (Schaefer-IPA) w/9-08512

FISHES OF THE KOSI SYSTEM, Natal Univ., Pietermaritzburg (South Africa). Dept. of Zoology. For primary bibliographic entry see Field 2L. W79-08318

THE POST-IMPOUNDMENT ICHTHYO-FAUNA OF THE J. G. STRIJDOM DAM, KWA-ZULU.

ZULU, Natal Univ., Pietermaritzburg (South Africa). H. M. Kok, S. J. M. Blaber, and G. C. B. Walley. South African Journal of Science, Vol. 74, No. 4, p 140-142, April 1978. 2 fig. 4 tab, 13 ref.

Descriptors: *Fish populations, *Dams, Impoundments, Fish types, Aquatic animals, Fish, Wildlife.

Group 2H-Lakes

J G Strijdom Dam, South Africa, Aquatic habitats, Spawning, Fish reproduction, Pongolo River.

The species composition, faunal changes that have occurred in the J. G. Stijdom Dam since its clo-The species composition, isaunal changes that have occurred in the J. G. Stijdom Dam since its closure, and the adaptation of rheophilic fish species to the lacustrine conditions in the dam were studied. In 1976, fish samples were taken in three monthly samples using gill nets, fry nets, and floodplain pans. Results show not only that the species composition changed from 1969, (the dam commenced filling in 1970) to 1976, but that there appears to be a differential distribution of species in the dam as predicted in earlier studies. Two major faunal changes were the absence of E. depressirostris, M. macrolepidotus, and Alestes imberi from the 1969 catches and the absence of Hydrocynus vittatus and Barbus marequensis from the 1976 catches. There was a noticeable change in the reversal in abundance of the two Labos species, L. rosse and L. rubropunctatus. The first is a benthic detritus feeder while the second prefers aufwuchs, and differential production rates of the selected food types may be favoring the second species. (Schaefer-IPA)
W79-08521 (Schaefer-II W79-08521

PRODUCTIVITY AND NUTRIENT EXPORT STUDIES IN A CYPRESS SWAMP AND LAKE SYSTEM IN LOUISIANA, Louisiana State Univ., Baton Rouge. Center for

Wetland Resources. For primary bibliographic entry see Field 2I. W79-08545

HYDROGEOLOGY OF THE LESSER SLAVE LAKE AREA, ALBERTA,

Research Council of Alberta, Edmonton For primary bibliographic entry see Field 2F. W79-08551

MODEL AND OBSERVED CIRCULATION THROUGHOUT THE ANNUAL TEMPERATURE CYCLE OF LAKE MICHIGAN,

Argonne National Lab., IL. Energy and Environ-mental Systems Div.

J. H. Allender, and J. H. Saylor. Journal of Physical Oceanography, Vol. 9, No. 3, p 573-579, May 1979. 6 fig, 1 tab, 12 ref.

Descriptors: *Circulation, *Lake Michigan, *Great Lakes, *Temperature, *Heat budget, *Mathematical models, Lakes, Currents(Water), Current meters, Heat flow, Wind velocity, Model studies, *Model verification, Temperature distributions, Model sensitivity, Wind stress.

Monthly average currents and temperatures pre-dicted by a three-dimensional, numerical model of Lake Michigan were compared with observations made in that lake during June-October 1976. The observed data were from 17 current meters with integral temperature recorders that were concentrated on a transverse section of the southern basin of the lake. A brief interpretation of the overall aspects of these data was given, and the evolution of a deep temperature anomaly in the west-central basin was discussed. Model results were evaluated in terms of their comparability with the dominant features of the observed data. Lakewide-average temperatures in the model were reasonable, and the signs of the computed and observed currents showed some agreement. However, the model exaggerated upwelling along the upwind (western) shore, leading to temperature predictions that worsen progressively throughout the stratified season. The present study and other recent work suggest the need for improved mixed-layer physics in lake models. (Adams-ISWS)

ATMOSPHERIC ENHANCEMENT OF METAL DEPOSITION IN ADIRONDACK LAKE SEDI-

Virginia Univ., Charlottesville. Dept. of Environmental Sciences For primary bibliographic entry see Field 5A.

IMPORTANCE OF WETLAND TYPES TO DUCK PRODUCTION AND TO NON-GAME BIRD POPULATIONS

South Dakota State Univ., Brookings. Dept. of Wildlife and Fisheries.

Wildlife and Fisheries.

L. D. Flake, and P. A. Vohs, Jr.

Available from the National Technical Information
Service, Springfield, VA 22161 as PB-298 610.

Price codes: A04 in paper copy, A01 in microfiche.
South Dakota Water Resources Institute, South
Dakota State University, Completion Report,
April 1979. 50 p, 101 ref. OWRT B-045-SDAK(1),
14-34-0001-6118.

Descriptors: *Ducks(Wild), *Non-game birds, *Wetlands, Water birds, Game birds, Waterfowl, Wildlife, Aquatic habitats, Shallow water, Lakes, Ponds, Stock water, Animal populations, Streams,

South Dakota wetlands were studied to determine their importance to waterfowl and some wetland bird populations. Baseline data were obtained; using multivariate techniques habitat relationships of common species of waterfowl were examined. Useful information in assessing and mitigating potential water resource development was provided by both the baseline data and the habitat analysis data. Information on variables important to waterfowl use of man-made wetlands was obtained from close examination of duck use of stock ponds. Stock ponds and semipermanent wetlands contained proportionally more pairs of most species than other wetland categories. The habitat associated with pairs of each species were described using multiple regression and discriminant analyses. Habitat variables explained 35-47% and 25-35% of the variation in pairs having small and large home ranges respectively. Important variables associated with breeding pair use of stock ponds were emergent vegetation species, height, and interspersion. Non-game birds most frequently used glacial pond types. (Schaefer-IPA) W79-08605

LAKE HURON WINTER CIRCULATION,

National Oceanic and Atmospheric Administra-tion, Ann Arbor, MI. Great Lakes Environmental Research Lab.

J. H. Saylor, and G. S. Miller. Journal of Geophysical Research, Vol. 84, No. C6, p 3237-3252, June 20, 1979. 24 fig, 16 ref.

Descriptors: *Water circulation, *Winter, *Lake Huron, *Great Lakes, Current meters, On-site in-vestigations, Temperature, Water temperature, Currents(Water), Circulation, Winds, Epilimnion, Lakes, Limnology, Climatology, Winter circula-

Twenty-one current meter moorings were de-ployed in Lake Huron during winter 1974-1975. The moorings were set in November 1974 and retrieved approximately 6 months later. The staretrieved approximately 6 months later. The sta-tions were configured on a coarse grid to measure the lake-scale circulation during winter. Water temperature was also recorded in nearly all of the 65 current meters deployed. Results revealed a strong cyclonic flow pattern in the Lake Huron Basin persisting throughout the winter. The ob-served winter circulation was in essence very simi-lar to what is now believed to be the summer lar to what is now believed to be the summer circulation of epilimnion water, although the winter currents penetrated to deeper levels in the water column and were more intense. Winter cywater column and were more intense. Winter cyclonic flow persisted in a nearly homogeneous water mass, while summer currents have been shown to exhibit an almost geostrophic balance with observed water density distributions. This suggests that the current field driven by prevailing wind stresses across the lake's water surface may be largely responsible for maintaining the horizontal gradients of water density observed in the lake during summer. Analyses of energetic wind stress impulses revealed the prevailing wind directions that drive the dominant circulations. When combined with results of summer surveys, the winter studies permit a description of the annual cycle of horizontal current speed variation with depth in horizontal current speed variation with depth in Lake Huron. (Sims-ISWS)

GROUND-WATER INDUCED CHANGES IN LAKE CHEMISTRY,
University of South Florida, Tampa. Dept. of Chemistry. For primary bibliographic entry see Field 4A. W79-08624

RATE OF AVAILABILITY OF TOTAL PHOS-PHORUS IN RIVER WATERS, West Virginia Univ., Morgantown. Dept. of Chemical Engineering. For primary bibliographic entry see Field 5B. W79-08626

WATER-QUALITY RECONNAISSANCE OF LAKES IN VOYAGEURS NATIONAL PARK, MINNESOTA, Geological Survey, St. Paul, MN. Water Re-sources Div. G. A. Payne. Geological Survey open-file report 79-556, 1979. 40 p, 1 fig. 1 tab, 4 ref.

Descriptors: "Water quality, "Lakes, "Minnesota, "Eutrophication, "National parks, Nutrients, Phytoplankton, Cyanophyta, Algae, Oligotrophyto, Water analysis, Chemical properties, Physical properties, Biological properties, Dissolved solids, Bottom sampling, "Voyageurs National Park(MN).

Water samples were collected from three lakes in Voyageurs National Park, MN., to assess chemical and biological water quality in March and August 1977. Bottom material samples also were collected and analyzed for chemical quality. Results of the analyses show that the water system was dilute; specific conductance ranged from 32 to 111 micromhos. Blue-green algae, particularly Oscillatoria, were the most common phytoplankton in the samples. Differences in water quality, shown particularly by concentrations of nutrients and dissolved solids, were detected between samples collected in different areas of the park. The collected data were used to design a monitoring program to assess eutrophication that may occur during the development of the park. (Woodard-USGS)

2I. Water In Plants

THE EFFECT OF THE METHOD OF IRRIGA-TION AND THE QUALITY OF THE WATER USED FOR SPRAYING ON THE INTENSITY OF RUSSETING IN GOLDEN DELICIOUS

APPLES, Fruit and Food Technology Research Inst., Stel-Fruit and Food Technology Research Land, delenbosch (South Africa).

J. H. Terblanche, and P. R. Jolly.
Deciduous Fruit Grower, Vol. 26, Part 12, p 484-488, December 1976. 3 fig, 2 tab, 8 ref.

Descriptors: *Apples, *Russeting, *Irrigation effects, Irrigation practices, Pesticides, Fruit crops, Pome fruits, Orchards, Surface irrigation, Sprinkler irrigation, Irrigation water, Dams, Boreholes, Water quality.

The possibility that the quality of water used for irrigation and for spraying may have an effect on russeting of golden delicious apples was investigated. Four treatments were applied in a random block design with four replications: two by overhead and two by under-tree irrigation. Pesticide sprays with borehole and dam water were used with each style of irrigation. Overhead irrigation produced more severe russeting than under-tree with each style of irrigation. Overhead irrigation produced more severe russeting than under-tree irrigation. When overhead irrigation was applied there was only a slight difference in the effect of borehole and dam water; when under-tree irrigation was applied, dam water induced a considerably higher intensity of russeting than borehole water. Russeting was black or brown; black occurred only where overhead irrigation and/or sprays were applied using dam water. The dam water differed from the borehole water in that the former contained iron (more than 1 ppm) and water discolored brown due to the presence of dissolved organic acids; it is impossible to determine from available data if russeting was due to the separate or combi (Schaefer W79-085

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Erosion and Sedimentation—Group 2J

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PRODUCTIVITY AND DECOMPOSITION OF THE DOMINANT SALT MARSH PLANTS IN LOUISIANA, Tulane Univ., New Orleans, LA. Dept. of Biology. D. A. White, T. E. Weiss, J. M. Trapani, and L. B.

Ecology, Vol. 59, No. 4, p 751-759, Summer, 1978. 5 fig. 3 tab, 40 ref.

Descriptors: *Primary productivity, *Salt marshes, *Louisiana, *Rooted aquatic plants, Standing crops, Biomass, Vegetation, Marshes, Coastal marshes, Wetlands, Litter, Decomposing organic matter, Roots, Gulf Coastal Plain.

matter, Koots, Gulf Coastal Plain.

Live and dead standing crops were calculated by the harvest method over an annual cycle. Litter-bags were used to estimate loss rates of vegetation from the marsh. Peak standing crops, in grams per square meter, were: Distichlis spicata, 1164; Spartina patens, 2194; Juncus roemerianus, 1999; and S. alterniflora, 1473. Net production estimates using the Smalley method, in grams per square meter per year, were: D. spicata, 1291; S. patens, 1342; J. roemerianus, 1740; and S. alterniflora, 1527. Using the Wiegert and Evans method, net production estimates, in grams per square meter per year, were: D. spicata, 1162; S. patens, 1428; J. roemerianus, 1806; and S. alterniflora, 2895. It is estimated that these four species produce 14,600,000 metric tons of plant material per year in Louisiana marshes. In general, production was higher for this Louisiana marsh than reported in Atlantic Coast marshes; decomposition rates were also considerably higher. (Stihler-Mass)

ESTUARINE PROCESSES, VOLUME I AND II. For primary bibliographic entry see Field 2L. W79-08543

FLUX OF ORGANIC MATTER THROUGH A SALT MARSH, Georgia Univ. Athens.
L. R. Pomeroy, K. Bancroft, J. Breed, R. R. Christian, and D. Frankenberg.
In: Estuarine Processes, Volume II, Circulation, Sediments, and Transfer of Material in the Estuary, M. Wiley, editor, Academic Press, New York, N.Y., 1976, p 270-279. 1 fig, 1 tab, 39 ref.

Descriptors: *Organic matter, *Salt marshes, *Ecology, Marshes, Wetlands, Energy, Carbon, Carbon dioxide, Algae, Rooted aquatic plants, Aquatic life, Sediments.

The transfer of organic matter from primary producers through consumers to CO sub 2 in terms of quality and quantity of carbon compounds was examined for a salt marsh ecosystem. In addition to production of particulate material, sources of solu-ble carbon compounds which may be significant were found. These included losses from both living and dead macrophytes, primarily Spartina, from algae in water and sediments, from excretion and feces of consumers, and from biological processes in the sediments. Since Spartina detritus is relatively indigestible, much of the flux of organic matter to detricuses must involve conversion of particular to detritovores must involve conversion of particulate detritus to soluble compounds and their assimilation by microorganisms, which can then be consumed by detritovores. Some dissolved material accumulates as a film on the surface of the water and is formed into organic aggregates. Several lines of evidence suggest that microorganisms in the water actively assimilate dissolved organic material during the growing season. Microorganisms in the sediments, although they reside in a large pool of organic matter, appear to be substrate-limited except near the sediment-water surface. (Stihler-Mass)

PRODUCTIVITY AND NUTRIENT EXPORT STUDIES IN A CYPRESS SWAMP AND LAKE SYSTEM IN LOUISIANA,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
J. W. Day, T. J. Butler, and W. H. Conner.
In: Estuarine Processes, Volume II, Circulation, Sediments, and Transfer of Material in the Estuary, M. Wiley, editor, Academic Press, New York, N.Y., 1976, p 255-269, 6 fig. 2 tab, 32 ref.

Descriptors: *Primary productivity, *Nutrients, *Swamps, *Lakes, Forests, Wetlands, Estuaries, Biomass, Litter, Seasonal, Carbon, Nitrogen, Phosphorus, Ecology.

phorus, Ecology.

During a 14-month period in 1973-74, the productivity of two swamp forest components (bottom-land hardwoods-BLH; baldcypress tupelo-CT), the productivity of lake and bayou waters, hydrology and carbon and nutrient export were studied in the upper drainage basin of the Barataria Bay estuary. Productivity of the BLH site was 800 g dry wt/sq m/yr for stem biomass increase, 584 for litterfall, and 200 for understory production. Similar figures for CT were 500, 620, and 20. Total above-ground net productivity was 1584 for BLH and 1140 for CT. Net daytime photosynthesis (NDP) for the lake was 1418 g 02/sq m/yr and nighttime respiration (NR) was 1868 (P/R = 0.76). For the bayous NDP was 316 and NR was 446 (P/R = 0.71). Water discharge from the basin is significant year-round except during the summer when evaporation equals precipitation. Annual export to the lower estuary (calculated from water discharge and materials concentrations) was 8016 metric tons of organic C, 1047 metric tons N, and 154 metric tons P. The greater part of this export occurred during the spring, corresponding to the spring peak in biological activity in the estuary. (Stihler-Mass)

MIDSUMMER STANDING CROPS OF WET-LAND SEDGE MEADOWS ALONG A TRAN-SECT FROM FOREST TO PRAIRIE, Minnesota Univ., St. Paul. E. Gorham, and J. M. Bernard. Journal of the Minnesota Academy of Science, Vol. 41, p 15-17, 1975. 1 fig, 2 tab, 14 ref.

Descriptors: *Wetlands, *Standing crops, *Minnesota, *Primary productivity, *Sedges, Forests, Grasslands, Rooted aquatic plants, Biomass, Peat, Carex sp.

Standing crops were measured in sedge meadows along a 135 km transect from forest to prairie in northwestern Minnesota. Eight of the meadows were located in forest sites; all but one were on waterlogged fibrous peat. These sites were dominated by Carex lacustris (4 sites), C. lasiocarpa (2), C. rostrata (1) and C. atherodes (1). Above-ground standing crops ranged from 425 to 738 g dry wt./sq m, with a mean of 606 g/sq m. The five prairie sites occurred on well-drained silty peats, and standing crops ranged from 679 to 1248 g dry weight per sq m, with a mean of 941 g per sq m. Above-ground standing crop in prairie site was 55% greater than in forest sites. (Stihler-Mass) W79-08546

HAS THE PRIESTLEY-TAYLOR EQUATION ANY RELEVANCE TO FOREST EVAPORA-TION,
Institute of Hydrology, Wallingford (England).
W. J. Shuttleworth, and I. R. Calder.
Journal of Applied Meteorology, Vol. 18, No. 5, p 639-646, May 1979. 4 fig, 1 tab, 30 ref.

*Evaporation, Precipiors: "Evaporation, Precipitation(Atmospheric), "Forest watersheds, Forestry, Forests, Radiation, Interception, Meteorological data, Soil moisture, Meteorology, Equations, Trees, "England, "Priestley-Taylor equation, "Forest evaporation, Net radiation, Potential evaporation, Meteorological conditions, Scots Pine forest Forest environment." Descriptors: oration, Meteorological of forest, Forest environment.

Long-term evaporation measurements were expressed in the Priestley-Taylor 'potential evaporation' framework for a spruce forest in Plynlimon, Wales, and a Scots Pine forest in Norfolk, England. The results were used to illustrate the possi-

bility of significant variability in evaporation from forest vegetation in response to precipitation input, and so provided a warning against the indiscriminate use of the Priestley-Taylor formula. A tentative suggestion was made regarding a possible role for potential evaporation in the forest environment. (Roberts-ISWS) W79-08552

HYDROLOGICAL, METEOROLOGICAL, AND AGRICULTURAL RELATIONS IN NORTHERN

IRAQ, Ministry of Irrigation, Baghdad (Iraq). For primary bibliographic entry see Field 3F. W79-08561

A TECHNIQUE FOR THE DIRECT MEASURE-MENT OF WATER STORAGE ON A FOREST

MENT OF MALES CANOPY, University of Strathclyde, Glasgow (Scotland). Dept. of Applied Physics.
For primary bibliographic entry see Field 2B. W79-08577

VEGETATION RESPONSE TO CONTOUR FURROWING,
Agricultural Research Service, Sidney, MT.
Northern Plains Soil and Water Research Center.
J. R. Wight, E. L. Neff, and R. J. Solseth.
Journal of Range Management, Vol. 31, No. 2, p
97-101, March, 1978. 3 tab, 2 fig, 8 ref.

Descriptors: *Contour furrows, *Range management, *Environmental effects, *Vegetation establishment, Furrow systems, Crop response, Runoff, Erosion, Panspot soils, Saline soils, Soil moisture, Vegetation effects, Water yield improvement, Land management, Montana.

Although contour furrowing was one of the first land surface modification treatments applied to rangeland to increase forage production and reduce runoff and erosion on fine-textured eroda-ble soils, more information is needed regarding the ble soils, more information is needed regarding the long term vegetation responses and site treatment interactions with this technique, accordingly, the purpose of the present paper is to examine the vegetation responses of panspot and saline upland range sites to contour furrowing over an eight year period in arid southwestern Montana. Sixteen 0.8 hectare watersheds, 12 on a panspot range site with average slopes of 1 to 50%, and 4 on a saline upland range site with an average slope of 3%, were established in November 1967, with half of the watersheds at each site being contour-furrowed the watersheds at each site being contour-furrowed with an arcadia model B contour furrower. Results with an arcadia model B contour furrower. Results indicated that contour furrowing increased average annual herbage production by 165% and plant available soil water by 107% and reduced basal cover 73% on the panspot range sites while it increased available water but had no significant effect on total herbage or basal cover on the saline-upland sites. These results are attributed primarily to the reduced surpract transft and increased over uphand sites. These results are attributed primarily to the reduced summer runoff and increased over winter recharge. It is concluded that contour furrowing can be an effective tool for increasing soil water and herbage production on panspot and saline upland range sites. (Tickes-Arizona) W79-08617

2J. Erosion and Sedimentation

ESTUARINE PROCESSES, VOLUME I AND II. For primary bibliographic entry see Field 2L. W79-08543

SUSPENDED LOAD FROM ERROR-FUNC-TION MODELS, Science and Education Administration, Oxford, MS. Sedimentation Lab. J. C. Willis, Journal of Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY7. Proceed-ings Paper 14684, p 801-816, July 1979. 6 fig. 1 tab. 17 ref, 2 append.

Descriptors: *Alluvial channels, *Hydraulics, *Rivers, *Model studies, Streams, Suspended load.

Group 2J-Erosion and Sedimentation

Turbulent flow, Sedimentation, Turbulence, Turbulent boundary layers, Equations, Sands, *Alluvial streams, Turbulent diffusivity, Concentration

Models for the vertical distributions of flow velocity and sediment concentration based on the as-sumption of an error-function distribution of turbulent diffusivity were used in calculating the sus-pended-load discharges for two sets of flume data. The flow and sediment variables required for the calculation procedure were the mean flow velocity, flow depth, shear velocity, and fall velocity and diameter of the sediment particles. For coarse sand (D = 0.54 mm), the effective bed concentrasand (D = 0.34 mm), the effective bed concentra-tion served as a convenient reference concentra-tion for the suspension calculations, but for the fine sand (D = 0.1 mm) for which statistical bed-form data were not available, a measured reference con-centration was required to facilitate agreement becentration was required to facilitate agreement between measured and calculated discharges of suspended sediment. For the 0.54 mm sand, the effective bed concentration was obtained from the probability density function of the bed surface, which could be approximated by a gamma function (1888). tion. (Lee-ISWS) W79-08559

THEORY OF MINIMUM RATE OF ENERGY

DISSIPATION, Bureau of Reclamation, Denver, CO. Engineering

and Research Center.
C. T. Yang, and C. C. S. Song.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY7, Proceedings Paper 14677, p 769-784, July 1979. 5 fig.

23 ref. 1 append.

Descriptors: *Fluvial sediments, *Open channel flow, *Power head, Energy dissipation, Hydraulics, Equations, Mathematical studies, Rivers, Alluvial channels, Theoretical analysis, Flow, Sediments, Turbulent flow, Laminar flow, Transition flow, *Fluvial hydraulics, Navier-Stoke's equation, Elwiel recents.* Fluvial processes.

A general theory of minimum rate of energy dissi-pation for a class of open channel flows with or without the movement of sediment was proposed in this paper. This theory states that the rate of energy dissipation is a minimum under steady equi-librium or gradually varied flow conditions. The theory was derived from the Navier-Stoke's equations of motion for gradually varied, open channel flow without sediment transport. It applies to turbulent and laminar flows as long as the inertia forces due to the time-averaged velocity distribu-tion are small compared with the forces due to gravity and shear. The theory in different degrees of generality can be used to explain the fluvial processes from the movement of sediment to the change of velocity, slope, roughness, channel ge-ometry, pattern, and profile of a river under an equilibrium condition or during the process of selfadjustment to reach an equilibrium condition. (Lee-ISWS) W79-08560

MINIMUM STREAM POWER AND RIVER CHANNEL PATTERNS, San Diego State Univ., CA. Dept. of Civil Engi-

San Diego neering. H. H. Chang. Journal of Hydrology, Vol. 41, No. 3/4, p 303-327, May 1979. 14 fig, 37 ref.

Descriptors: *Channel morphology, *Rivers, *Streams, Sediments, Transport, Flow resistance, Valleys, Equations, Alluvial channels, Meanders, Descriptors: Hydraulics, Slopes, Sediment discharge, Discharge(Water), Bedload, Velocity, *Stream power, Channel patterns, Valley slope, Braided

Channel patterns of sand-bed rivers were analyzed using the concept of minimum stream power together with formulas for flow resistance and sediment transport. A diagram was constructed, on the plane of water discharge vs. valley slope, dividing regime rivers into straight, meandering, and braided patterns in plan configuration. The analytical

diagram was supported by river data and previous observations. For the given water discharge Q and sediment load Q sub s, the stable channel geometry and slope were obtained from the stream power analysis, wherein a stable configuration is assumed analysis, wherein a stable configuration is assumed to correspond to a minimum stream power per unit channel length. For small values of Q and Q sub s, the analysis showed that a unique minimum exists, indicating a unique stable channel configuration and slope. With this unique stable channel slope equal to the valley slope, the channel pattern is straight. Above a certain threshold valley slope, the stream power actually has two minimums, indicating two possible stable channel configurations and slopes. Whenever multiple channel slopes exist on a uniform valley slope, the river must be sinuous. The reason for meandering development was attributed to minimum stream power per unit channel length for the river system, because with its attributed to minimum stream power per unit chan-nel length for the river system, because with its multiple configurations and slopes, a meandering river may minimize its stream power expenditure as well as its sediment load for the river system subject to physical constraints. Analytical relations also predicted that highly sinuous rivers which are small in width/depth ratio occur on flatter valley slopes and that they become more braided and less sinuous as the valley slope increases. (Lee-ISWS) W79.08567

ATMOSPHERIC ENHANCEMENT OF METAL DEPOSITION IN ADIRONDACK LAKE SEDI-

Virginia Univ., Charlottesville. Dept. of Environ-

For primary bibliographic entry see Field 5A. W79-08581

INSTABILITY OF ALLUVIAL VALLEY FLOORS: A METHOD FOR ITS ASSESSMENT, Geological Survey of Israel, Jerusalem; and Colorado State Univ., Fort Collins.

Z. B. Begin, and S. A. Schumm.

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Transactions of the American Society of Agricultural Engineers, Vol. 22, No. 2, p 347-350, March-April 1979. 6 fig, 9 ref. OWRT B-150-COLO(1), 14-34-0001-7143.

Descriptors: *Alluvium, *Valleys, *Stability, *Gullies, Erosion, Gully erosion, Washouts, Sediments, On-site investigations, Data processing Mathematical models, Stress, Shear stress, Drainage, Geomorphology, *Alluvial valley floors.

Using previously collected data on the morphology of semiarid valleys, a technique was developed for discriminating between stable and unstable valley floors. Relations between drainage area, discharge, and flow depth were used to develop a shearstress indicator that can be used to identify those reaches of a valley floor that are most likely to fail by gullying. (Sims-ISWS)

DISTRIBUTION OF HYDROCARBONS IN NARRAGANSETT BAY SEDIMENT CORES, Rhode Island Univ., Kingston. Graduate School of

Oceanography.
For primary bibliographic entry see Field 2A.
W79-08625

BED PARTICLE REYNOLDS MODELLING FOR FLUID DRAG, Science and Education Administration, Oxford, MS. Sedimentation Lab.

N. L. Coleman. Journal of Hydraulic Research, Vol. 17, No. 2, p 91-105, 1979. 8 fig, 14 ref.

Descriptors: *Bed load, *Model studies, *Sediment transport, Reynolds number, Drag, Streambeds, Shear drag, Hydraulics, Erosion, Streamflow, Riprap, Flow, Velocity, *Fluid drag, Bounded shear flow, Shear velocity.

A scaled-up Reynolds model of a sediment particle on a streambed has been used to study the drag force exerted by streamflow. The results have been presented as a data trend relating particle drag coefficient to particle Reynolds number. The

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modified drag coefficient and Reynolds number used take into account the presence of bounded shear flow by using a characteristic velocity deter-mined from the relation between the approach flow velocity and the shear velocity on the stream-bed. (Lee-ISWS) W79-08630

SUSPENDED- AND BEDLOAD-SEDIMENT TRANSPORT IN THE SNAKE AND CLEARWA-TER RIVERS IN THE VICINITY OF LEWIS-TON, IDAHO, AUGUST 1976 THROUGH JULY

Geological Survey, Boise, ID. Water Resources

Div. M. L. Jones, and H. R. Seitz. Geological Survey open-file report 79-417, 1979. 87 p, 22 fig, 16 tab, 10 ref.

Descriptors: *Sediment transport, *Baseline studies, *Pre-impoundment, *Post-impoundment, *Idaho, Hydrologic data, Suspended load, Bted load, Streamflow, Channel morphology, Data collections, Sedimentation, *Snake River(IA), *Clear-inches and the street of the street water River(IA).

Water in the Snake and Clearwater Rivers was impounded beginning June 1975 when Lower Granite Dam became operational. Construction and operation of this facility necessitated collection of hydraulic- and channel-geometry data and description of sediment-transport characteristics in these rivers. This report summarizes information collected during August 1976 through July 1978 and is the fifth in a series of similar reports that began in 1972. Relatively minor amounts of sediment were transported during the 1977 drought began in 1972. Relatively minor amounts of sedi-ment were transported during the 1977 drought period. Therefore, regular scheduled sampling of the bedload was impractical. Data for the 1978 runoff period indicate lower-than-average sedi-ment transport in both rivers. Combined 1978 totals show that about 1,200,000 tons of sediment passed the Lewiston area. Hydrologic data collect-ed from March 1972 through July 1978 are shown by various graphical presentations. (Woodardvarious graphical presentations. (Woodard-W79-08700

2K. Chemical Processes

FLUX OF ORGANIC MATTER THROUGH A SALT MARSH,
Georgia Univ. Athens.

For primary bibliographic entry see Field 2I. W79-08544

SIMULTANEOUS TRANSPORT OF WATER AND REACTING SOLUTES THROUGH MULTILAYERED SOILS UNDER TRANSIENT UNSATURATED FLOW CONDITIONS, Argonne National Lab., IL. Div. of Environmental

Impact Studies.
For primary bibliographic entry see Field 2G.
W79-08570

HYDROLOGICAL APPLICATIONS OF NOBLE GASES AND TEMPERATURE MEASURE-MENTS IN UNDERGROUND WATER SYSTEMS: EXAMPLES FROM ISRAEL, Weizmann Inst. of Science, Rehovot (Israel). For primary bibliographic entry see Field 2G. W79-08571

EVAPORATION OF WATER FROM SAND: THE EFFECT OF EVAPORATION ON THE PRECIPITATION OF SALTS DISSOLVED IN WATER STORED IN SAND,

National Inst. for Water Research, Windhoek (South West Africa). For primary bibliographic entry see Field 2D. W79-08574

ION EXCHANGE REACTIONS IMPORTANT IN GROUNDWATER QUALITY MODELS, Geological Survey, Denver, CO. Water Resources

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Saline Water Conversion—Group 3A

For primary bibliographic entry see Field 6A. W79-08643

2L. Estuaries

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ST. LUCIA ESTUARY: EVALUATION OF NAT-URAL RESOURCES, Town and Regional Planning Commission, Pieter-maritzburg (South Africa). A. M. Little, and A. J. Phelan. South Africa Journal of Science, Vol. 74, p 8-11, January 1978. 5 fig, 1 ref.

Descriptors: *St Lucia Estuary, *Land use, *Estuarine environment, Estuaries, Aquatic environment, South Africa, Natural resources, Recreation facilities, Conservation, Resources, Water resources development, Mapping, Evaluation, Parks.

A procedure for evaluating the natural resources of the recreation resort, the St. Lucia Estuary, in order to indicate its optimum land use management is described. The area under study covered 3,700 hectares characterized by high coastal dunes, a unique dune forest, and excellent sport fishing. The flood plains of the Umsinduzi and Umfolozi rivers add diversity to the ecosystem including areas of papyrus and reed swamp, mangrove, exotic and coast forest, vlei and bush grassland, and pans. A broad evaluation to determine those areas most suitable for development was conducted so as to select three distinctive zones: areas sensitive to man's instrustion which should be set aside in a conservation zone, areas suitable for limited recreation, and areas suitable for more intensive recreation and/or urban occupation. Five evaluation criteria were considered essential for zone determination; an analysis of these identified 16 vegetation communities. These 16 were grouped into 4 classes according to conservation importance. Factor according to conservation importance. Factor maps were superimposed and studied for correlations, anomalies, and distinctive patterns. By assigning a numerical score to each map grid square, zones which had the same scores could be grouped. There was flexibility in the planning and use of areas; boundaries between zones are seen as points on a continuum rather than as clearly defined lines. (Schaefer-IPA)
W79-08510

FISHES OF THE KOSI SYSTEM,
Natal Univ., Pietermaritzburg (South Africa).
Dept. of Zoology.
S. J. Blaber.

Lammergeyer, Vol. 24, p 28-41, March 1978. 2 fig, 7 tab, 14 ref, 1 append.

Descriptors: *Fish types, *Estuarine environment, *Lakes, Lake Nhlange, Lake Sifungwe, Lake Mpungwini, Lake Amanzimnyama, South Africa, Fish populations, Fish, Aquatic animals, Freshwater fish, Saline water fish, Estuaries, Saline

The very diverse fish fauna of each part of the The very diverse lish fauna of each part of the Kosi system was studied to establish the important characteristics and seasonal variations of the fauna. The Kosi system consists of four district but connected basins, each with different physical characteristics and seasonal variations of the fauna. The system drains to the sea through a usually permanently open estuary. Five samplings of fish were taken per annum for 1975, 1976, and 1977 using gill, seine, and fry nets and an open water trawl. Physical characteristics of the system important to Physical characteristics of the system important to the fish populations include tides, current speeds, salinity, water temperatures, substrate, and plant detritus. The three most important are: (1) the virtual separation of Sifungwe and Mpungwini by virtual separation of Situngwe and Mpungwini by low water levels during neap tides and droughts, (2) the current speeds in the reed channel between Sifungwe and Nhlange which may exceed those at the estuary mouth during rainy season and (3) a combination of low temperatures and low salinities of Lake Nhlange. A total of 124 species of marine fishes (not including freshwater species) were recorded. About 70% were restricted to the estuary and the reef within the estuary; the remainder were estivaring resident species and auchalling marine estuaring marine. estuarine resident species and euryhaline marine species which penetrate the system to a varying

extent. Seasonal changes in distribution and density are described for some of the species, and related where necessary to physical characteristics of the different regions. (Schaefer-IPA) W79-08518

ESTUARINE PROCESSES, VOLUME I AND II. M. Wiley, editor, Academic Press, New York, N.Y. 1976. 969 p.

Descriptors: *Estuaries, *Wetlands, *Physical properties, *Biological properties, *Ecology, Circulation, Marshes, Tidal marshes, Salt marshes, Remote sensing, Fish, Nutrients, Wildlife, Invertebrates, Rooted aquatic plants, Sediments, Mathematical models ematical models.

Volume I--subtitled, Uses, Stresses and Adaptation to the Estuary--contains 37 papers in the following seven categories: Rehabilitation of estuaries, Nutrient cycling in estuaries, Population dynamics, Wetland uses, Behavior as a measure of sublethal stress, land uses, Behavior as a measure of sublethal stress, Physiological and biochemical adaptations and Cycling of pollutants. Volume II-subtitled, Circulation, Sediments, and Transfer of Material in the Estuary-contains 27 papers in the following six categories: Effects of physical alterations, Introduction to sedimentary processes I; Suspended sediment transport and circulation, Introduction to sedimentary processes II: Suspended sediment transport and circulation, Interactions between tidal wetlands and coastal waters, Circulation models and Tools and methods. Each volume contains an index. (Stihler-Mass)

WIND-DRIVEN CIRCULATION IN THE CHESAPEAKE BAY, WINTER 1975, Johns Hopkins Univ., Baltimore, MD. Chesapeake Bay Inst.
D.-P. Wang.
Journal of Physical Oceanography, Vol. 9, No. 3, p 564-572, May 1979. 6 fig, 9 ref. OCE 74-08463, OCE 77-20254.

Descriptors: *Circulation, *Estuaries, *Currents(Water), *Frequency, *Chesapeake Bay, *Stratified flow, Wind velocity, Velocity, Salinity, Mathematical models, Saline water intrusion, Tidal waters, Model studies, Wind stress, Volume flux, Salinity distributions.

Nontidal circulation in Chesapeake Bay was examined from one-month current records at 50 and 200 hed from the entrance. The monthly mean flow was basically a two-layered circulation; in addi-tion, there were large wind-driven velocity fluctu-ations at several-day time scales. Corresponding to velocity changes, the salinity distribution had large variations, comparable to its seasonal change. Bay water responded to longitudinal (local) wind and coastal (nonlocal) Ekamn flux. The response was barotropic in the lower Bay, and baroclinic (frictional) in the upper bay. The difference in response characteristic appears to be due to the counter-effects of the near-surface windstress shear and the death independent surface. depth-independent surface single. A frictional model accounted for most of the observed features. Results of this study provided further evidence of large, atmospherically induced exchange between the estuary and coastal ocean. The importance of wind on upstream salt intrusions was also clearly demonstrated. (Adam, ISWS) demonstrated. (Adams-ISWS) W79-08555

ENLARGEMENT OF MARCUS HOOK AN-CHORAGE, DELAWARE RIVER, Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. R. F. Athow, Jr. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A030 541, Price codes: A06 in paper copy, A01 in microfiche. Miscellaneous Paper H-76-17, September 1976. 4 fig, 8 tab, 13 photo, 53 plate, 6 ref.

Descriptors: *Delaware, *Density currents, *Model studies, *Tides, *Currents(Water), *Bays, *Delaware River, Salimity, Dispersion, Shoals, Navigation, Navigable waters, Dredging, *Tidal currents, Tidal heights.

An existing comprehensive physical model that correctly reproduced tides, tidal currents, and density currents throughout the entire Delaware Bay and River was used to determine the effects of enlargement of the Marcus Hook Anchorage. The study included tests in the model of the plan configuration to define its effects on tidal heights, current velocities, salinities, surface current paterns, dye dispersion, and postdredging shoal developments. Based on the results of the model tests, the following conclusions were reached: (1) the plan would have no effect on tidal heights or tidal phasing; (2) the effects of the plan on current velocities and patterns would be minimal; (3) the tidal phasing; (2) the effects of the plan on current velocities and patterns would be minimal; (3) the plan would not significantly change the salinity regime when low-flow conditions allow salinity to intrude into the study area; (4) the plan caused a trend for dye concentrations to increase within and in the immediate vicinity of the Marcus Hook Anchorage for dye released between the main navigation channel and the proposed enlargement; and (5) the effects of the plan on shoaling rates would be to increase the efficiency of the Marcus Hook Anchorage as a sediment trap, due to the enlarged cross-sectional area. It was concluded that although no significant change in the shoaling rate in the navigation channel would be observed, a redistribution of the shoaling in the study reach can be expected. (Bhowmilk-ISWS)

DISTRIBUTION OF HYDROCARBONS IN NARRAGANSETT BAY SEDIMENT CORES, Rhode Island Univ., Kingston. Graduate School of Oceanography.

For primary bibliographic entry see Field 2A.

W79-08625

POTENTIAL POLLUTION OF A MARINE EN-VIRONMENT BY LEAD ALKYLS: THE CAVTAT INCIDENT, Istituto di Ricerca sulle Acque, Bari (Italy). For primary bibliographic entry see Field 5C. W79-08627

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALINATION TODAY, National Inst. for Water Research, Pretoria (South Africa). G. R. Botha, and G. L. Dalton. Scientiae, Vol. 18, No. 4, p 2-11, December 1977.

Descriptors: *Desalination, *Desalination processes, Vapor compression distillation, Sea water, Desalination apparatus, Desalination wastes. South Africa, Water treatment, Membranes, Evaporators. Distillation, Electrodialysis, Freezing, Reverse osmsosis, Ion exchange, Solar distillation. Costs.

Desalination technology is examined for the world in general and for South Africa in particular. Due to the high unit cost of the product water, desalination is only likely to come into its own in areas where alternative supplies are not available or are extremely costly. The four basic types of distilla-tion plants in use are examined: multistage, multiple effect, vapor compression, and solar evapora-tors. Four other desalination processes are discussed. The freezing process has operated only on a small experimental basis. This process is consid-ered unduly complex and its possible cost advantage are not felt to justify the added complexity Electrodialysis is a highly efficient process but has Electrodialysis is a highly efficient process but has been shown to be economical only with brackish waters of relatively low salinity. Reverse osmosis systems are comparatively simple and have shown good performance results: significant improve-ments are expected and these will lower the cost. Ion exchange is a simple, reliable, low-cost process sometimes used in conjunction with other of the processes. Solar evaporation, distillation, freezing, and electrodialysis are considered as possible

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A—Saline Water Conversion

means of brine disposal; the first appears to be the only option for South Africa. Much of the research effort in South Africa is being expended on reverse osmosis; the role of desalination in sewage reclamation is also being investigated. (Schaefer-IPA) W79-0851

3C. Use Of Water Of Impaired

GEOTHERMAL POWER PRODUCTION WITH

RRIGATION WASTE WATER,
Science and Education Administration, Phoenix,
AZ. Water Conservation Lab.
H. Bouwer.

Ground Water, Vol. 17, No. 4, p 375-384, July-August 1979. 6 fig. 3 tab, 32 ref.

Descriptors: *Irrigation water, *Thermal power, *Waste water, Water reuse, Water resources, Impaired water use, Injection wells, Heated water, Steam, Thermal water, Thermal powerplants, Geothermal studies, Saline water, Salinity, Energy, Irrigation waste water.

Both irrigated agriculture and areas with dry, hotrock formations at relatively small depth are ubiquitous in the western United States. The former uitous in the western United States. The former produces saline percolation water, while the latter needs water to transfer the heat to the surface to enable exploitation of the geothermal energy. Thus, it seems logical to investigate the possibility of converting irrigation return flow, which often presents an environmental liability, into a useful asset by pumping it into artificially stimulated hotrock formations. When brought up as hot fluid, the water can then be used for generating power, producing freshwater, and/or space heating. The paper summarized quantity and quality of irrigation return flow, various types of geothermal systems, and quantities of power and freshwater that can be derived from steam or hot water. (Simscan be derived from steam or hot water. (Sims-W79-08619

3D. Conservation In Domestic and Municipal Use

WATER ECONOMY -- WHERE TO SOUTH

AFRICA, Council for Scientific and Industrial Research, Pretoria (South Africa). Building Services Div H. R. Boyd.

Municipal Engineer, Vol. 9, No. 1, p 55-59, January/February 1978.

Descriptors: *Water conservation, *Water utiliza-*Domestic water, Municipal water, consumption(Except consumptive use), Waste disposal, South Africa, Lawns, Recirculated wastes, Water policy, Domestic wastes, Wastes, Sewage, Urine, Toilets.

The current thinking on water economy measures in urban areas is reviewed. Those measures appropriate for immediate application and measures which are more relevant to future conditions are suggested. Possible reductions in water demand, if such measures were applied, are assessed. The present need in South Africa is for cheap, simple economy measures that will cause little disruption to the traditional activities of water users. Sophisticated methods can be considered, developed, and progressively introduced in time, after the simpler means. Alternatives to the ordinary wash-down water-closet (W.C.) with flushing cistern include dual flush cisterns, reduced flush volume cisterns, use of waste water from sinks, baths, and hand wash basins for flushing, and chemical incinerat-ing, composting, biological, oil flushed, vacuum, and recirculating toilets. Modifications to urinals include reductions of flushing water, waterless uri-nals, and shutting off the water in periods of non-use. Spray mixer taps could cause significant water economies in W.C. compartments and cloakrooms. Smaller baths and atomizer nozzles are suggested for baths and showers. Washing machines, dish-washers, and sink waste disposal units are the principal water using domestic appliances; rede-

signing machines and using machines only for full loads could conserve water in washers. Car wash-ing and garden watering are two more areas where water can be conserved. (Schaefer-IPA) W79-08584

3F. Conservation In Agriculture

WATER FOR THE HIGHVELD,

Rhodesia Dept. of Conservation and Extension, Salisbury. G. J. Wilson

Rhodesia Science News, Vol. 12, No. 1, p 14-18, January 1978. 2 fig. 1 tab.

Descriptors: *Irrigation practices, *Irrigation effects, Rhodesia, Irrigated land, Irrigation programs, Arable land, Soil-water-plant relationships, Water management(Applied), Water policy, Agriculture, Crops, Water resources, Productivity.

The present impact of irrigation on the Highveld, the use of available water resources, and the future pattern of irrigation development are discussed.
Competition for water among agriculture, industry, and domestic uses is already evident in Rhodesia. The total irrigation area on the Highveld is estimated at 300,000 hectares. The catchment areas for runoff required to supply the irrigation require-ments of various crops differ from area to area. A balanced apportionment of runoff between farm dam storage in the upper catchment and major storage works downstream is needed. The increase storage works downstream is needed. In encrease in crop yield and crop value due to irrigation must cover the investment for irrigation equipment, maintenance, and power. The profitability of the scheme will depend to a large extent on whether the equipment can be used on winter and summer crops. The appropriate system of planting and irrigation depends on the crops response to water stress. The economic considerations of irrigation make it very unlikely that the maize growing areas will extend significantly into drier parts. Irrigation is expected to cause expansion in the production of wheat, tobacco, ground-nuts, coffee, cotton, and other vegetable and fruit crops. (Schaefer-IPA) W79-08514

HYDROLOGICAL, METEOROLOGICAL, AND AGRICULTURAL RELATIONS IN NORTHERN IRAQ,

Ministry of Irrigation, Baghdad (Iraq). F. Y. El Yussif.

Water Resources Bulletin, Vol. 15, No. 3, p 753-765, June 1979. 12 fig, 6 tab, 6 ref.

Descriptors: *Crop production, *Precipitation(Atmospheric), *Irrigation, Wheat, Barley, Runoff, Rainfall, Crops, Rainfall-runoff re-lationships, Agriculture, Hydrology, Meteorologi-cal data, Meteorology, *Iraq, *Northern Iraq.

The northern regions of Iraq, an area comprised of mountains and undulating plains, has for centuries been the main granary for the country. Its agriculbeen the main granary for the country. Its agricultural production is largely dependent upon natural rainfall, which ranges from about 300 to 1,000 mm/yr. Grain yields can be greatly improved by use of improved varieties and management practices. Equations were developed to show relationship between various hydrologic and meteorologic parameters with yields of wheat and barley. The amount of supplementary water needed to maximize grain yields was also shown. (Sims-ISWS) W79-08561

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

CONTROL OF WATER HYACINTHS IN SOUTH AFRICA. Munisipale Ingenieur, Vol. 8, No. 6, p 39-43, No-

vember/December 1977

Descriptors: *Water hyacinth, *Aquatic weed control, Aquatic plants, Aquatic weeds, Herbicides, Biocontrol, Diquat, Paraquat, Clarosan, Mechanical control, Insects, Snails, Pathogenic fungi, Fish, Mammals, Chemcontrol, South Africa.

Mammals, Chemcontrol, South Africa.

The present state of controlling water hyacinths (Eichhornia crassipes) in South Africa is examined. Methods of control are biological, chemical, and mechanical; only a few of the possibilities can be applied under local conditions. Of all the biological control agents only five groups or organisms have shown some promise: insects, snails, phytopathogens, fish, and mammals. Biological control is the ideal solution to the problem, but there are difficulties involved with this method. They include: (1) all natural enemies of the hyacinth are tropical species and need to be laboratory-reared in South Africa, (2) fish and mammals are not suited to South African conditions, (3) phytopathogens must be monitored to prevent their attacking food crops, and (4) the biological process is very lengthy. Three herbicides have been passed for use: Paraquat, Diquat, and Clarosan. They are cheap, rapid, effective and easy to use; their disadvantages make them a practical means as an emergency measure. enecuve and easy to use; their disadvantages make them a practical means as an emergency measure. Mechanical control is possible but has the draw-back that the biomass of the plant must be used. The plant matter can be used as animal feed and compost, and in the production of paper, gas, alcohol, and protein, but there are other and more economical sources for all these. (Schaefer-IPA) W79-08515

ECOLOGICAL INVESTIGATION OF DAMS IN THE UMFOLOZI GAME RESERVE, Natal Parks Board, Pietermaritzburg (South Africa). Hluhluwe Game Reserve. For primary bibliographic entry see Field 7A. W79-08522

FLOODPLAIN PAINS, Texas A and M Univ., College Station. J. McNeely. Tierra Grande, No. 7, p 12-15, Second Quarter

Descriptors: *Flood control, *Flood plains, *Water management(Applied), Flood plain insurance, Runoff, Flood forecasting, Floods, Flood recurrence interval, Insurance, Economics, Flood plain zoning, Flood damage, Property values, Flood Disaster Protection Act of 1973, National Flood Insurance Act.

Flooding and floodplain management programs are discussed. Several factors, usually interrelated, affect flooding problems. The type of problems are primarily determined by the general climatic zone of the watershed concerned. Surface and subsurface geologic materials, steepness of slope, width of a floodplain, stream densities, and stream flow conditions all affect runoff. Land use and treatment conditions all affect runoff. Land use and treatment can affect runoff and resultant flooding adversely or favorably. Parks, greenbelt areas, and other such land uses aid floodwater removal, and decrease runoff and damages. The conversion of land from open space or agricultural use to urban use increases the impervious area; the costs and damages associated with increased flood hazard may cause property values to decrease. Structural flood control methods have been popular with planners in the Texas area. Storm water runoff is regulated by modifying the topography in a way that avoids in the Texas area. Storm water runoft is regulated by modifying the topography in a way that avoids changing the runoff pattern. The National Flood Insurance Actand the Flood Disaster Protection Act of 1973 aid in providing disaster relief. Housing and Urban Development (HUD) requirements for floodplain controls are aimed at removing unsafe structures from the floodplain and preventing new ones from being built. State and Federal ing new ones from being built. State and Federal Government agencies generally support HUD-originated control; local governments generally desire local control. (Schaefer-IPA) W79-08597

ENLARGEMENT OF MARCUS HOOK ANCHORAGE, DELAWARE RIVER,

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Groundwater Management—Group 4B

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. For primary bibliographic entry see Field 2L. W79-08610

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GROUND-WATER INDUCED CHANGES IN LAKE CHEMISTRY, University of South Florida, Tampa. Dept. of

Oniversity of South Fibrus, ample Dept. Chemistry. P. M. Dooris, and D. F. Martin. Groundwater, Vol. 17, No. 4, p 324-327, July-August 1979. 1 fig. 1 tab, 13 ref.

Descriptors: "Water chemistry, "Lakes, "Groundwater, "Florida, Pumping, Water quality, Hydrogen ion concentration, Hardness(Water), Carbon, Rainfall, Dry seasons, Aquatic plants, "Lake Starvation(FL), "Lake Hobbs(FL), Augmentation, Floridan aquifer.

Significant changes in the relative proportions of 8 major ions in lake waters can be ascribed to large-scale augmentation of lakes with water pumped from the Floridan aquifer. The pre-augmentation diagram for Lake Starvation matches the ionic diagram for Lake bobs, while the post-augmentation diagram for Starvation is virtually identical to the ionic diagram. tion diagram for Starvation is virtually identical to the ionic diagram for groundwater from the Flori-dan aquifer. Finally, the ionic diagrams for Lake Hobbs (which was not subjected to groundwater augmentation) showed that the relative propor-tions of the 8 ionic constituents have not changed. (Visocky-ISWS) W79-08624

MATHEMATICAL MODEL FOR SIMULATING DISCHARGES ON THE SABINE RIVER BETWEEN TATUM AND RULIFF, TEXAS, Geological Survey, Baton Rouge, LA. Water Resources Div.
B. L. Neely, Jr. Geological Survey open-file report 79-566, April 1979. 31 p, 15 fig, 9 tab, 4 ref.

Descriptors: *Mathematical models, *Simulation analysis, *Streamflow, *Flood routing, *Reservoir releases, Natural flow, Rainfall-runoff relationships, Precipitation excess, Hydrographs, Reach(Streams), Texas, Louisiana, Dams, *Toledo Bend Reservoir, *Sabine River, *Tatum(TX), *Ruliff(TX).

A mathematical model for simulating discharges on the Sabine River between Tatum and Ruliff, TX., was developed to evaluate the effects of release schedules on discharges from the Toledo Bend Reservoir compared to discharges under natural conditions. Using the discharge at Tatum, TX., the rainfall over the basin, and the discharge release schedule for the reservoir, discharge hydrographs for the natural and reservoir-controlled conditions can be computed. (Woodard-USGS) W79-08695

DEVELOPMENT OF A SORBENT DISTRIBUTION AND RECOVERY SYSTEM,
Seaward International, Inc., Falls Church, VA.
S. H. Shaw, R. P. Bishop, and R. J. Powers.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB-290 347,
Price codes: A05 in paper copy, A01 in microfiche.
Report EPA-600/7-78-217, 1978. 76 p, 25 fig, 4 tab,
5 ref, 1 append.

Descriptors: *Oily water, *Oil spills, *Sorption, *Polymers, *Plastics, Separation techniques, Oil wastes, Reclamation, Porous media, Water treatment, Water pollution.

A foam sorbent prototype system was developed and tested for the recovery of oil spilled on surface waters. The reusable sorbent foam is a high tensile, open cell polyurethane with a density of 16-32 kg/cu m and a pore size of 1-3 pores/mm with an absorbing capacity of up to 30 times its weight; up to 90% of the oil was removable by squeezing the foam. The foam is in the form of small cubes and the entire mobile system may be transported in two pickup trucks. A pneumatic broadcaster transports and distributes the foam sorbent over the affected

water and an inclined open wire mesh belt convey-or recovers the saturated sorbent from the water. The sorbent is squeezed in a converging belt press or regenerator to recover oil and water and is returned to the water following regeneration. The system managed sweep speeds up to 5 knots in calm and turbulent water, achieving oil recovery rates of 10.5 cu m/hr. The oil content of the recovered liquid in the sorbent ranged from 38-79%. (Lisk-FRC) W79-08743

COOPER RIVER ENVIRONMENTAL STUDY, South Carolina Water Resources Commission, Co-

Report No. 117, F. P. Nelson, Editor, April 1974. 164 p, 27 fig, 1 append.

Descriptors: *Cooper River(SC), *Charleston Harbor(SC), *Diversion, *Saline water intrusion, *Sediment transport, *Low flow, *Silting, *Environmental effects, Water levels, Water pollution sources, Water management(Applied), Dredging, Channel improvement, Biochemical oxygen demand, Saline water-freshwater interfaces, Atlantic Ocean, Santee-Cooper River Diversion Project(SC), Water supply, River basin development, Watersheds (Basins), Bottom sediments, Sedimentation, Municipal wastes, Industrial wastes, Estuaries, Baseline studies.

A comprehensive baseline study of biochemical and physical parameters of the Cooper River in South Carolina shows that projected rediversionary streamflow reduction from 15,600 avg wkly cfs to 3000 cfs would reduce siltation in Charleston Harbor (caused by diversion since 1942 of large volumes of Santee River water into the Cooper River system) and would alleviate need for continued extensive harbor dredging. However, the proposed rediversion could conceivably generate a number of negative water quality and quantity effects: (1) Salt water encroachment under reduced flow conditions could endanger the fresh water supply for some industrial and urban users. (2) Severe oxygen depletion could result from rediversupply for some industrial and urban users. (2) Severe oxygen depletion could result from rediversion, and might necessitate imposition of waste load limits into the river system. (3) Residual waste in the river, caused by industrial and municipal effluents, might be transported upstream by Atlantic Ocean tides during periods of minimum river flow. On the other hand, a mixed saltwater-freshwater estuarial condition would provide for more rapid seaward transport of bottom materials (as existed before 1942); removal of such deposits would reduce oxygen uptake potentials in the would reduce oxygen uptake potentials in the lower Cooper River and elsewhere in the harbor and alleviate concern that septicity could occur during periods of low flow and elevated tempera-ture. (Harris-Wisconsin) W79-08830

4B. Groundwater Management

ARTIFICIAL RECHARGE IN SOUTH PLATTE RIVER BASIN, Bureau of Reclamation, Denver, CO. L. K. Weston, and R. E. Swain.
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol. 105, No. IR2. Proceedings paper 14606, p 117-127, June 1979. 4 fig, 13 ref, 2 append.

Descriptors: *Artificial recharge, *Groundwater recharge, *Groundwater resources, *Colorado, *Aquifer management, *Irrigation water, Equations, Aquifers, Water rights, Surveys, Water quality, *South Platte River, Water resources management. Water allocation

A reconnaissance study of the potential for artifi-cially recharging the alluvial aquifer along 110 miles of the South Platte River from Fort Morgan miles of the South Platte River from Fort Morgan to Julesburg, Colorado, was made based on published hydrologic and geologic information. Analyses were made to determine the availability of water for recharge; anticipated infiltration rates; potential storage capacity of the groundwater reservoir; the degree of groundwater mounding beneath potential recharge sites; the magnitude of

annual drain-out loss to the river; possible water quality problems; and the potential effects on the South Platte River flows. Artificially recharging the alluvial aquifer appears technically feasible. Water-logging conditions are likely to develop in areas that lie within 1 mile or 2 miles of the river. Due to the high dissolved solids concentration of the recharge water, the quality of the groundwater in some areas may deteriorate and preclude its use for domestic and municipal water supplies. (Adams-ISWS)

ADVANCES IN GROUNDWATER HYDROL-OGY. For primary bibliographic entry see Field 2F. W79-08631

STATUS OF QUANTITATIVE GROUND-WATER HYDROLOGY, Geological Survey, Reston, VA. Water Resources

J. D. Bredehoeft.

J. D. Bredehoeft.

In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 8-14, September 1976. 1 fig, 7 ref.

Descriptors: *Reviews, *Hydrogeology, *Ground-water movement, Theoretical analysis, Evaluation, Model studies, Groundwater resources, Ground-water availability, Aquifer management.

water availability, Aquifer management.

Several numerical methods have been developed for solving problems of groundwater flow. These models are identified according to the problems they address as follows: (1) flow; (2) transport, including the transport of chemical constituents and energy; (3) coupled groundwater and surface water; (4) coupled groundwater and economics; and (5) more global water-resources model, which include groundwater, and are State, regional, or national in scope. Management decisions are classified as (1) engineering, in which satisfying demands at a minimum cost is included, together with feasibility - will the aquifer provide the quantity of water needed for a desired period; (2) optimizations, in which the attempt is made to maximize benefits, usually economic benefits; and (3) institutional questions - those that are commonly directed toward the legal institutions. One can picture these decisions as being increasingly oriented toward policy questions. Given these classifications of models and management decisions, the use of the models in addressing problems of water-resource management is examined. (See also W79-08633) W79-08633

WATER RESOURCES OF THE SANTA YNEZ INDIAN RESERVATION, SANTA BARBARA COUNTY, CALIFORNIA, Geological Survey, Menlo Park, CA. Water Resources Div.

J. A. Singer.

A usulable from CESS, USCA, B.

Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO. 80225, Paper copy \$4.00, microfiche \$3.50. Geological Survey open-file report 79-413, March 1979, 27 p. 9 fig. 3 tab. 9 ref.

Descriptors: *Groundwater resources. *Pumping. *Drawdown, *Water quality. *Indian reservations. California, Surface-groundwater relationships. Water wells, Water pollution sources, *Santa Ynez Indian Reservation(CA), Paso Robles Formation. Zanja de Cota Creek, Careaga Sand.

The Santa Ynez Indian Reservation is situated above a bedrock ridge that forms the southern boundary of the Santa Ynez upland ground-water basin. A pumping depression exists upgradient from the reservation, and water levels have declined an average of 1.0 to 1.5 feet per year since the 1940's. This decline in the water level has led to the cessation of perennial flow in Zanja de Cota Creek that traverses the reservation. In the past this creek was fed by the natural discharge of water from the ground-water basin. Water-bearing rock beneath the reservation is limited in thickness.

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Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4B-Groundwater Management

and may become unusable as a water supply source in the near future if water levels continue to decline. The chemical quality of water beneath the reservation is generally acceptable for both irrigation and domestic use; however, large-scale pumping could induce the flow of contaminated water from an area just upgradient. Declines in groundwater levels and the existence of fecal contamination upgradient from the reservation make the successful development of a ground-water supply successful development of a ground-water supply for the reservation doubtful. (Woodard-USGS)

WATER-LEVEL PREDICTIONS FOR INDIAN WELLS VALLEY GROUND-WATER BASIN, CALIFORNIA, 1978,

Geological Survey, Menlo Park, CA. Water Resources Div.

For primary bibliographic entry see Field 6A. W79-08699

4C. Effects On Water Of Man's Non-Water Activities

WATER CHEMISTRY OF THE REDWOOD CREEK AND MILL CREEK BASINS, RED-WOOD NATIONAL PARK, HUMBOLDT AND DEL NORTE COUNTIES, CALIFORNIA,

Geological Survey, Menlo Park, CA. Water Resources Div.

W. L. Bradford, and R. T. Iwatsubo.

W. L. Bragford, and K. 1. Iwatsubo. Available from the National Technical Information Service, Springfield, VA 22161 as PB-296 253, Price codes: A06 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-115, December 1978. 112 p, 18 fig, 20 tab, 45

Descriptors: "Water quality, "Lumbering, "Environmental effects, "Streams, "Water pollution, National parks, Water types, Water chemistry, Nitrogen, Regolith, Soil water, Weathering, California, "Redwood National Park.

A two-year study made in Redwood National Park, Calif., (September 1973-September 1975) determined existing chemical water-quality conditions and identified possible effects of logging on water quality in streams. Water quality was generally good, with dissolved-solids concentrations ranging from 25 to 139 milligrams per liter in the Redwood Creek basin and 21 to 49 milligrams per liter in the Mill Creek basin. Water type and pH tended to shift seasonally. Exposure of soils to the elements in areas logged or having naturally sparse elements in areas logged or having naturally sparse vegetation accelerated chemical weathering and increased dissolved-solids concentrations. Nitrogen and phosphorus concentrations were generally too and prosphorus concentrations were generally too low to support nuisance algae, but were higher in logged areas. Higher nitrogen concentrations in areas well exposed to sunlight could support modest algae populations. Trace-metal concentra-tions were low, typical of clean streams. (Woo-derd 1963) dard-USGS) W79-08691

4D. Watershed Protection

NONPOINT SOURCE CONTROL GUIDANCE, HYDROLOGIC MODIFICATIONS.

Environmental Protection Agency, Washington,

DC. Water Planning Div.

Available from the National Technical Information
Service. Springfield, VA 22161 as PB-268 709, Price codes: A06 in paper copy, A01 in microfiche. Technical Guidance Memorandum TECH-29, February 1977. 105 p. 3 fig. 12 ref, 3 append.

Descriptors: *Water pollution, *Water pollution Descriptors: water poliution, "water poliution sources, "Water poliution control, Sediments, Sediment control, Nutrients, Thermal pollution, Chemicals, Channel improvement, Dredging, Floodways, Drainage, Ditches, Runoff, Storm water, Water quality, "Hydrologic modifications," *Best management practices.

Organizations designated to develop comprehensive land and water use plans impacting on water quality management have a responsibility to establish regulations for control of nonpoint pollution sources. The EPA policy requiring establishment of such regulations is contained in the 'Draft Guidelines for State and Areawide Water Quality Management Program Development', February 1976. EPA is currently developing nonpoint source pollution regulatory guidance to provide additional assistance to State and areawide 208 planning agencies in their nanpoint source control additional assistance to State and areawide 208 planning agencies in their nonpoint source control programs. This guidance document presents Best Management Practices (BMP) related to hydrologic modifications that the comprehensive plan may incorporate and be implemented through such regincorporate and be implemented through such reg-ulations. The hydrologic modifications nonpoint source pollution control guidance document is pro-vided to assist State and areawide 208 planning agencies in carrying out their water quality man-agement and implementation policies. Emphasis has been focused on the need to prevent those circumstances and situations involving comprehen-tive land and water supprehensively descriptions. sive land and water management plan development which will produce nonpoint source pollution as a result of hydrologic modifications through applica-tion of Best Management Practices. (Sims-ISWS)

5. WATER OUALITY MANAGEMENT AND **PROTECTION**

5A. Identification Of Pollutants

WATER QUALITY IN MOUNTAIN RECRE-

ATIONAL AREAS,
California Univ., Los Angeles, Office of Environmental Science and Engineering.
For primary bibliographic entry see Field 5B.
W79-08580

ATMOSPHERIC ENHANCEMENT OF METAL DEPOSITION IN ADIRONDACK LAKE SEDI-

Virginia Univ., Charlottesville. Dept. of Environ-mental Sciences.

J. N. Galloway, and G. E. Likens. Limnology and Oceanography, Vol. 24, No. 3, p 427-433, May 1979. 4 fig, 4 tab, 14 ref. OWRT A-067-NY(2).

Descriptors: *Lake sediments, *Metals, *New York, *New Hampshire, *Atmosphere, *Fallout, *Northeast U.S., Chemicals, Chemical analysis, Chemistry, Sediments, Cores, Heavy metals, Trace elements, Lakes, On-site data collections, Analytical techniques, Pollutants, Path of pollutants, Water pollution, Water pollution sources, Sedimentation, Limnology, *Adirondack State Park(NY), *Mt. Washington(NH), *Woodhull Lake(NY), *Honnedaga Lake(NY), *Lake of the

Sediment cores were collected from Woodhull Lake (Adirondack State Park, New York) in July 1975. Of 44 metals analyzed by neutron activation and atomic absorption spectrophotometry, 9 (Ag, Au, Cd, Cr, Cu, Pb, Sb, V, and Zn) showed increased rates of deposition in the last 30 years. These increases are attributed to increased rates of atmospheric deposition. Similar results were obtained from cores of Honnedaga Lake (Adirondack State Park) and Lake of the Clouds (Mt. Washington, New Hampshire). (Sims-ISWS) W79-08581

THE OUESTION OF NITRIFICATION IN THE PASSAIC RIVER, NEW JERSEY: ANALYSIS
OF HISTORICAL DATA AND EXPERIMENTAL INVESTIGATION,

Rutgers-The State Univ., New Brunswick, NJ. Dept. of Environmental Science.

Dept. of Environmental Science.

J. Cirello, R. A. Rapaport, P. F. Strom, V. A. Matulewich, and M. L. Morris.

Water Research, Vol. 13, No. 6, p 525-537, 1979. 10 fig. 6 tab, 23 ref. OWRT A-053-NJ(2).

Descriptors: *Nitrification, *Rivers, *New Jersey, Nitrogen, Nitrogen compounds, Nitrates, Ammo-nia, Ions, Anions, Cations, Sampling, Chemical analysis, Bacteria, Plankton, Nutrients, Pollutants, Pollutant identification, *Passaic River(NJ).

Pollutant identification, *Passaic River(NJ).

Historical NH4(+) and NO3(-) data from 6 stations on the Passaic River, New Jersey, were analyzed. The data for 5 of the stations span 1963 to 1976, and for the 6th station, 1947 to 1976. Some of the conclusions reached are as follows: (1) The concentration of NH4(+) fluctuated widely, but the trend was towards an increase with time. (2) The concentration of NH4(+) was elevated during a period of extreme drought (1963 to 1966). (3) The concentration of NO3(-) tended to increase smoothly with time. (4) The concentration of NH4(+) increases longitudinally (with downstream travel). (5) The loads (concentration x stream-flow) of both nitrogen species tended to increase with time. (6) Substantial NO3(-) enters the stream from non-point sources. (7) The potential for instream nitrification is not fully realized, as represented by elevated levels of NH4(+). The analyses were discussed from a regulatory perspective. It was concluded that the nitrification component of the Passaic's self-purification capacity is overburdened, and first became so in 1953. (Sims-ISWS) ISWS) W79-08582

COASTAL WATER RESEARCH PROJECT: ANNUAL REPORT FOR THE YEAR 1978. Southern California Coastal Water Research Project, El Segundo

1979 Bascom, W., Ed. 246 p, 65 fig, 42 tab, 99 ref, 4 append.

Descriptors: *Coasts, *Water pollution, *Pollutant identification, Benthic fauna, Aquatic life, Aquatic animals, Infaunal index, Research and development, Data collections, Marine animals, Water pollution effects, Water pollution sources.

Information is presented on research projects that were successfully completed in 1978 by the staff of the Southern California Coastal Water Research Project. The research centered on pollution in coastal waters: (1) identifying polluted areas on the bottom by using the condition of the bottom and the benthic infauna; (2) obtaining a knowledge of what normal conditions in any coastal area should be; (3) taking many measurements, and examining and plotting data on possibly polluted areas and extending into undisturbed regions; and (4) developing a data-based system of logic for selecting the boundaries between areas that are normal, changed, and degraded. The Infaunal Index is presented as a new monitoring method which uses a changed, and degraded. The Infaunal Index is pre-sented as a new monitoring method which uses a simple number to describe the condition of the community of small animals that live in the bottom. The characteristics of the present and future wastewater discharges in southern Califor-nia are summarized. The biological consequences of a changing environment are examined for the coastal area for the last ten years. (Schaefer-IPA) W79-08585

RADIOMETRIC METHOD FOR THE DETER-MINATION OF URANIUM IN WATER: SINGLE-LABORATORY EVALUATION AND COLLABORATIVE INTERLABORATORY

INTERLABORATORY
STUDY,
Mound Facility, Miamisburg, OH.
C. T. Bishop, V. R. Casella, and A. A. Glosby.
Report No. EPA-600/7-79-093, April 1979. Prepared for the Environmental Protection Agency,
Environmental Monitoring and Support Laboratory, Las Vegas, Nevada. 48 p, 11 tab, 16 ref, 4
append. EPA-IAG-D6-0015.

Descriptors: *Uranium radioisotopes, *Laboratory tests. Water pollution control, Radioisotopes, Water pollution sources, Precipitation(Chemical). Methodology, Testing procedures, Analytical techniques, Radioactivity techniques, Waste identification.

The results of a single-laboratory evaluation and an interlaboratory collaborative study of a candidate method for determining the concentration of urani-

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Identification Of Pollutants-Group 5A

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um isotopes in water are presented. The procedure consisted of coprecipitation of uranium with ferrous hydroxide because this method was easy, fast, and gave a high recovery. A nitric-hydrofluoric acid dissolution was used in the sample contained sediment. The uranium was separated from other elements present by anion exchange chromatography and underwent subsequent electrodeposition on stainless steel slides. Alpha pulse-height analysis was used for counting the uranium activity. Four reference samples, ranging up to 2,000 disintegrations/minute/liter were prepared for procedure evaluation and for use in the collaborative study. Results of the collaborative study agreed with the reference values to within 5% in the case of higher level samples. Chemical recoveries averaged about 70%. The method was shown to be relatively simple and accurate. (Schaefer-IPA) W79-08600

WATER QUALITY GUIDELINES FOR ACID MINE DRAINAGE AND STRIP MINE AREAS

MINE DRAINAGE AND STRIP MINE AREAS IN IOWA,
Energy and Mineral Resources Research Inst.,
Ames, IA. Dept. of Animal Ecology.
For primary bibliographic entry see Field 5B.
W79-08611

RATE OF AVAILABILITY OF TOTAL PHOS-PHORUS IN RIVER WATERS, West Virginia Univ., Morgantown. Dept. of Chemical Engineering. For primary bibliographic entry see Field 5B. W79-08626

RELATIONSHIP BETWEEN SUMMER MEAN AND MAXIMUM CHLOROPHYLL A CON-CENTRATIONS IN LAKES, Colorado State Univ., Fort Collins. Dept. of Civil

Engineering. R. A. Jones, W. Rast, and G. F. Lee. Environmental Science and Technology, Vol. 13, No. 7, p 869-870, July 1979. 1 fig. 1 tab, 6 ref.

Descriptors: *Chlorophyll, *Lakes, *Regression analysis, Equations, Average, Phosphorus, Secchi disks, Data processing, Eutrophication, Meso-trophy, Oligotrophy, Water bodies, Summer, Algae, Water quality, Water pollution, Maximum chlorophyll, Mean chlorophyll, Relationships.

Based on literature values from approximately 50 water bodies, an empirical relationship has been developed between the summer mean and summer maximum chlorophyll a levels in water bodies. Where chlorophyll is expressed in micrograms/liter, this relationship is: maximum = 1.7 (mean) + 0.2 (Sims.ISWS) 0.2. (Sims-ISWS) W79-08628

ENVIRONMENTAL EFFECTS OF WESTERN COAL COMBUSTION PART 1 - THE FISHES OF ROSEBUD CREEK, MONTANA, Montana Fish and Game Dept., Miles City.

A. A. Elser, and J. C. Schreiber.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-289 882, Price codes: A03 in paper copy, A01 in microfiche. U. S. Environmental Protection Agency, Report EPA 600/3-78-098, 34 p, 1978. 8 fig. 11 tab, 17 ref.

Descriptors: *Montana, *Rosebud Creek, *Fort Union Coal Basin, Coal mines, Coal combustion, Mining, Biological communities, *Freshwater fish, *Fish populations, Fish reproduction, Fish management, Environmental effects, Planning, Biological surveys, Energy.

Fish populations have been studied during 1975 and 1976 in Rosebud Creek, a prairie stream which flows through the Fort Union Coal Basin in southeastern Montana. The objectives of this study was to collect fish population data to determine any immediate effects, and to act as a yardstick for assessing possible future effects of accelerated activities of coal mining and coal combustion in this region. Fishes were inventoried at nine stations and included 21 species representing nine families. Fish species diversity increased in a downstream direction.

tion, and tributaries contained many of the same fish species as in Rosebud Creek. The seasonal occurrence of reproductively mature game fishes in the lower region of Rosebud Creek suggests that it is used for spawning by fishes from the Yellowstone River. During the study, there was no apparent effect of either coal mining or coal combustion activities on the distribution of fishes in Rosebud Creek. (See also W79-08658) (Katz-EIS) W79-08657

ENVIRONMENTAL EFFECTS OF WESTERN COAL COMBUSTION PART II - THE AQUATIC MACROINVERTEBRATES OF ROSEBUD CREEK, MONTANA, Montana State Univ., Bozeman. Dept. of Biology. S. F. Baril, R. J. Luedtke, and G. R. Roemhild. Available from the National Technical Information Service, Springfield, VA 22161 as PB-291 211, Price codes: A05 in paper copy, A01 in microfiche. U. S. Environmental Protection Agency, Report EPA 600/3-78-099, 74 p, 1978. 13 fig. 17 tab, 59 ref.

Descriptors: "Montana, "Rosebud Creek, "Fort Union Coal Basin, "Colstrip, "Coal mines, Coal combustion, Mining, Biological communities, En-vironmental effects, Water pollution effects, Bio-logical survey, Energy, Benthos, "Aquatic insects, Coal fired power plants, Turbidity, Suspended solids, Faunal variation.

The aquatic macroinvertebrates of Rosebud Creek, Montana, were sampled between February 1976 and March 1977 to provide data on their abundance, distribution, and diversity. The sampling program was initiated during the first year of operation of the coal-fired power plants located at Colstrip, Montana. The purpose of the study was to determine if any immediate impacts of the power plant operation on the macroinvertebrate communities of Rosebud Creek could be detected and to provide data for comparisons with future studies. Rosebud Creek supported a diverse bottom fauna with high population numbers composed of species adapted to the turbid, silty conditions which are common in the prairie streams of eastern Montana. Intact riparian vegetation appeared to be important in maintaining stream bank stability and provided an essential food source. It was concluded that faunal variation among sampling stations provided an essential food source. It was concluded that faunal variation among sampling stations during the study period was attributable to physical factors including turbidity, water temperature, current velocity, and substrate, and not to potential impacts from coal mining and combustion. (See also W79-08657) (Katz-EIS)

THE ACUTE TOXICITY OF ZINC TO RAINBOW AND BROOK TROUT. COMPARISONS IN HARD AND SOFT WATER, Environmental Research Lab., Duluth, MN. For primary bibliographic entry see Field 5C. W79-08659

CHANGES IN PLANKTON AND BENTHOS OF THE SEA OF AZOV UNDER THE INFLUENCE OF ANTHROPOGENIC FACTORS, Azovskii Nauchno-Issledovatelskii Inst. Rybnogo Khozyaistva, Rostovna-Donu (USSR). V. P. Zakutskiy, A. Ya. Aldakimora, L. I. Tolokonnikova, G. S. Gunia, and V. A. Kopets. Hydrobiological Journal, Vol. 14, No. 1, p 22-27, 1978. 14 ref (Translated from Russian).

Descriptors: *Salinity, *Dams, Hydrology, Plankton, Benthos, *Don River, *USSR, Sea of Azov, Nutrients, Gulf of Taganrog, Commercial fisheries. Fish management, Microbiology, Microflora, Phytoplankton, Zooplankton, Zoobethos, Mollusks, Animal computations: Animal populations.

Damming of the Don River in the USSR has decreased the inflow of freshwater and nutrient salts into the Sea of Azov and consequently, increased the salinity of water in the Sea itself and in the Gulf of Taganrog. Food availability decreased at all levels of the food chain and the structure of plankton and benthos coenoses was altered. Black Sea species of little value began to penetrate into

the Sea of Azov. Regulation of the water supply through the Kerch Strait and intensification of fish breeding work are therefore essential measures for the protection of this unique body of water. Changes in composition of the microflora, phytoplankton, zooplankton and zoobenthos are described. (Katz-EIS)

A NEW UNITED STATES BIOMONITORING SYSTEM FOR THE AQUATIC ENVIRONMENT,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiolo-

gii. L. P. Braginskiy. Hydrobiological Journal, Vol. 14, No. 1, p 63-68, 1978. 4 ref. (Translated from Russian).

Descriptors: Fresh water, *Monitoring, *Bio-monitoring, *BIO-STORET, Toxicity, Analytical techniques, Aquatic environment, Aquatic populations, Methodology, Data collections, Data processing, *Data storage and retrieval, Data transmission, Water quality, Modelling, On-site-investigations.

The main principles of a new system (BIO-STORET) for monitoring the water environment, developed and tested in the United States, are described. The system is based on biotests which measure a set of hydrobiological and toxicological characteristics of aquatic ecosystems. A digital code for fresh and salt water biota and a system for the transmission of encoded information have been devised. The data processing center uses 300 computers. The data obtained are used widely for monitoring water quality and to forecast possible changes in aquatic ecosystems. (Katz-EIS) W79-08661

PHYTOPLANKTON IN THE NOVO-BAVARS-KOYE RESERVOIR AS AN INDICATOR OF TYPE AND THE BIOLOGICAL-SANITARY CONDITION OF A LAKE, Kharkov State Univ. (USSR). R. P. Zhupanenko, and A. V. Basina. Hydrobiological Journal, Vol. 14, No. 1, p 68-71, 1978. 18 ref. (Translated from Russian).

Descriptors: *Reservoirs, Dams, Water supply, *Kharkov, *USSR, Udy River, Phytoplankton, Water quality, Biomass, *Primary productivity, Plankton, Phytoplankton, Distribution, Saporobic activities, Seasonal changes, Water pollution effects, Nutrients, Nova-Bavarskoye Reservoir.

Data are presented on the morphology and hydrology of the Novo-Bauarskoye reservoir, built in 1970 within the city limits of Khar'kov for the purposes of improvement of the city's water supply. Also given are data on the chemical composition of its water, as well as the species composition, abundances and biomass of phyto-plankton found in it. Seasonal changes in phytoplankton and irregularities in its distribution through the reservoir are noted. The waters of the Novo-Bavarskoye Reservoir can be classified as mesosaprobic with low saprobial activity in summer and high activity in winter. The water is of the best quality in the winter. (Katz-EIS)

DETERMINATION OF PENTACHLORO-PHENOL IN MARINE BIOTA AND SEA WATER BY GAS-LIQUID CHROMATO-GRAPHY AND HIGH-PRESSURE LIQUID CHROMATOGRAPHY, Environmental Research Services, Gulf Breeze,

L. F. Faas, and J. C. Moore. Journal of Agricultural and Food Chemistry, Vol. 27, p 554-557, 1979. 1 fig. 3 tab. 18 ref.

Descriptors: Water pollution effects, Path of pollutants, Phenols, *Pentachlorophenol. *Mullets, *Shrimp, *Oysters, Mugil, Palaemonetes, Crassostrea, *Methodology, Chemical analysis, Tissue concentration, Sea water, Chromatography, Laboratory tests, Detection limits, Tissue analysis.

A method is described for measuring pentachloro-phenol (PCP) in samples from the estuarine envi-

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Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A-Identification Of Pollutants

ronment. Gas-liquid chromatography (GLC) is used to determine PCP residues in tissues as low as 0.01 ppm. Application of the method to exposed organisms indicates that PCP accumulates in mullet (Mugil cephalus), grass shrimp (Palaemonetes pugio), and eastern oysters (Crassostrea virginica). Sea water concentrations as low as 0.002 ppb. may be detected by formation of the amyl diazohy-drocarbon derivative. Ultraviolet detection limits for PCP by LC are 5.0 ppm in tissues and 2.0 ppb in seawater. (Katz-EIS) W79-08664

THE WEST FALMOUTH OIL SPILL: HYDRO-CARBONS IN THE SALT MARSH ECOSYS-

Victoria Ministry for Conservation, Melbourne (Australia).

Estuarine and Coastal Marine Science, Vol. 8, p 349-360, 1979. 3 fig, 3 tab, 21 ref.

Descriptors: Water pollution effects, Path of pollutants, *Oil, *Oil spills, Sediments, Marshes, Marine animals, *West Falmouth, Massachusetts, *West Falmouth oil spill, Salt Marsh Coast, Marine fish, Chemical analysis, No 2 fuel oil, Petroleum hydrocarbons, Marsh plants, Fundulus, Uca, Allkanes, Naphthenes.

Marsh surface sediments, cores, and organisms were analysed for hydrocarbons from one to seven years after the spill in September 1969 of No. 2 fuel oil at West Falmouth, Massachusetts. All organ-isms analysed showed contamination initially. Fundulus were nearly free of oil after one year but Uca remained heavily contaminated for at least four years. Alkanes disappeared in sediments after about 4 years while heavy aromatics and naphthenes persisted throughout the study. (Katz-EIS) W79-08666

LEAD ACCUMULATION IN AQUATIC PLANTS FROM METALLIC SOURCES IN-

PLANTS FRUM METALLIC SOURCES AND CLUDING SHOT,
Montana Univ., MO. Dept. of Botany.
M. J. Behan, T. B. Kincaide, and W. I. Selser.
Journal of Wildlife Management, Vol. 43, No. 1, p
240-244, 1979. 3 tab, 13 ref.

Descriptors: *Lead, *Path of pollutants, *Animal pathology, Toxicity, Heavy metals, Waterfowl, Aquatic plants, Absorption, Mallard Duck, Rooted aquatic plants, Plant physiology, Water pollution sources, Water pollution effects.

Ingestion of lead shot has caused the deaths of thousands of waterfowl during the past several decades. Plants absorb lead from diverse sources decades. Plants absorb lead from diverse sources such as lead additives in engine fuels release, into the atmosphere and geologic deposits of lead. The authors attempted to determine if rooted aquatic plants could absorb enough lead supplied in metallic form to be a potential cause of plumbism in waterfowl. In several different experiments the authors found that even though rooted aquatic lants can absorb lead from soils containing metalplants can absorb lead from some comment to accu-lic lead or lead shot, they do not appear to accu-mulate lead in concentrations sufficiently high to be a dietary factor leading to plumbism. The au-thors' results indicate that those factors involving the availability, ingestion, and absorption of lead directly from shot should continue to occupy the primary attention of those investigating the etiology of plumbism in waterfowl. (Deal-EIS) W79-08670

PECULIAR ACCUMULATION OF COBALT-60 BY THE BRANCHIAL HEART OF OCTOPUS, National Inst. of Radiological Sciences, Nakamin-ato (Japan). Marine Radio-Ecological Research

M. Nakahara, T. Koyanagi, T. Ueda, and C.

Bulletin of the Japanese Society of Scientific Fisheries, Vol. 45, No. 4, p 539, 1979. 1 tab, 3 ref.

Descriptors: *Cobalt radioisotopes, *Absorption, *Animal physiology, *Bioaccumulation, *Octopus, *Japan, *Tissue analysis, Cobalt, Radioactivity

techniques, Tracers, Path of pollutants, Water chemistry, Radiochemical analysis, Animal metab-

Octopus (Octopus vulgaris) were exposed to 0.5 uCi/L Cobalt-60 for 30 days. Following exposure various tissues were analyzed for radioactivity using a well-type scintillation detector. Among the tissues and organs measured, branchial heart showed the highest affinity for Cobalt-60. The affinity decreased in the following order: gill, liver, kidney and others. The concentration factors of the branchial heart, gill, liver and kidney were 24,000, 480, 240 and 230, respectively. The branchial heart did not show a high affinity for cesium-137 in a previous experiment. (Deal-EIS)

EXPERIMENTAL INTENSIVE CULTURE OF TIGER MUSKELLUNGE IN A WATER REUSE

SYSTEM,
Michigan Dept. of Natural Resources, Mattawan.
Wolf Lake State Fish Hatchery.

C. H. Pecor.
The Progressive Fish Culturist, Vol. 41, No. 2, p 103-108, 1979. 4 fig, 2 tab, 10 ref.

Descriptors: *Water reuse, *Growth rates, *Aqui-culture, *Pikes, Fish physiology, Water chemistry, Recirculated water, Dissolved oxygen, Hydrogen ion concentration, Ammonia, Fish hatcheries, Fry, Tiger muskellunge

Tiger muskellunge 14.5 cm long were reared for 45 days in a three-pass (pass I, II, and III) water reuse system. Cumulative growth rates for the fish were 0.143 cm/day in the first use of the water (pass I), 0.125 in the second use (pass II), and 0.108 in the third use (pass III). Food conversions were poorer in passes II and III. Survival of fish in each pass was good and no abnormal mortalities or disease problems were encountered. Dissolved oxygen, problems were encountered. Dissolved oxygen, ammonia, and pH data indicated that oxygen consumption and ammonia production had daily minimum values between 0200 and 0600 h and maximum values between 1600 and 2000 h. Maximum un-ionized ammonia levels of 0.0172 mg/L were recorded in pass III. Average daily oxygen consumption and ammonia production rates were 97 goxygen per kilogram of food fed (97 g oxygen/per 3400 kcal) and 6 g ammonia per kilogram of food fed and were substantially lower than corresponding rates reported for salmonids. (Deal-EIS) W79-08672

DETERMINATION OF TRACE ELEMENTS IN MARINE ORGANISMS-II RELATIONSHIP BE-TWEEN THE BODY SIZE OF SARGASSUM HORNERI AND CONCENTRATION OF IRON

(IN JAPANESE), National Inst. of Radiological Sciences, Nakamin-ato (Japan). Marine Radio-Ecological Research

Bulletin of the Japanese Society of Scientific Fisheries, Vol. 45, No. 4, p 459-464, 1979. 6 fig, 1 tab,

Descriptors: *Iron, *Growth rates, *Phaeophyta, *Japan, *Tissue analysis, Trace elements, Metals, Size, Weight, Plant physiology, Chemical analysis,

The concentration of iron in the brown algae, Sargassum horneri, of various growing stages col-lected on the coast of Ibaraki prefecture was determined to examine the relationship between body size and concentration of iron. The concentrations of iron showed significant differences among 45 samples and ranged from 66 to 640 micrograms/g dry weight. The concentration in algal bodies as dry weight. The concentration in algal bodies as well as in each organ of the algae tended to decrease remarkably with increasing body size. The distribution of iron among the organs of Sargassum horneri was not homogeneous; lamina showed the highest concentration of iron. The basal lamina of the main stipe accumulated iron about five times higher than the upper lamina of the branch around the growing point. Variation in weight percent of the growing point. Variation in weight percent of each organ to body weight was observed with increasing body size and the weight percent of

lamina tended to decrease exponentially. (Deal-EIS) W79-08673

HEAVY METAL CONTENTS IN DEEP-SEA FISHES (IN JAPANESE), Tokyo Univ. of Fisheries (Japan). Lab. of Food Hygienic Chemistry. R. Kobayashi, E. Hirata, K. Shiomi, H. Yamanaka, and T. Kikuchi.

Bulletin of the Japanese Society of Scientific Fisheries, Vol. 45, No. 4, p 493-497, 1979. 4 fig, 1 tab, 16 ref. (English summary).

Descriptors: "Heavy metals, "Absorption, "Fish physiology, "Tissue analysis, "Bioaccumulation, "Arsenic, "Selenium, Mercury, Cadmium, Zinc, Lead, Chemical analysis, Commercial fishing, Depth, Public health, Deep water habitats, Marine fish Metabul mercure." fish, Methyl mercury.

In order to examine whether deep-sea fishes were safe to eat, heavy metal contents were determined in the muscles of 16 species caught off New Zealand and Patagonia. Heavy metal contents determined in the muscles of deep-sea fishes were as follows: 0.04 to 0.46 ppm of total mercury, 0.02 to 0.44 ppm of methyl mercury, 0.08 to 0.46 ppm of selenium, trace to 0.03 ppm of cadmium, 4.3 to 10.9 ppm of zinc, trace to 0.53 ppm of lead, and 0.12 to 9.99 ppm of arsenic. The mercury contents of dory, Cytotidopus sp., and Tarakhii, Cheilodacty-lus macropterus, exceeded the temporary regulatory level of mercury in fishes and shellfishes. The contents of selenium, cadmium, zinc, and arsenic in the muscles of deep-sea fishes were about the same as those of commercial fishes, but lead was present at somewhat higher levels in the muscles of deep-sea fishes. In the muscle of dory, the amounts of total mercury and methyl mercury were found to be proportional to body weight. There exists a significant correlation between the depth of the sea where the fishes are caught and the contents of total mercury in the muscles, that is, the deeper the fishes live, the higher the contents of total mercury found in these fishes. (Deal-EIS)

NEW FLOATING TRAP FOR CAPTURING AND PRESERVING EMERGING AQUATIC IN-

SECTS, Columbia National Fisheries Research Lab., MO. T. P. Boyle. The Progressive Fish Culturist, Vol. 41, No. 2, p 108-109, 1979. 1 fig, 11 ref.

Descriptors: *Research equipment, *Aquatic insects, *Species diversity, *Monitoring, On-site investigations, On-site data collections, Sampling, Insects, Growth stages, Aquatic populations, Life history, Studies, Secondary productivity, Analytical techniques.

Several studies in which the efficiency of different types of emergence traps was compared showed that floating traps caught the greatest number and diversity of species. The frame construction of the emergence trap described here is like that of a pyramid trap. The frame is covered with a sheet of clear polyethylene. The collecting portion of the trap is based on a modified Malaise design. Thirty-six floating pyramid traps with the newly designed collecting device were tested in 12 ponds. The traps were serviced weekly with adequate results. No insects, dead or alive, were found outside the collecting jar. Although the traps have survived high winds, rain, and hail with no damage, their use probably should be restricted to calm waters. The trap is selective only against insects too large to enter the holes around the top of the funnel, such as dragonflies; larger insects may be accommodated by enlarging the holes. (Deal-EIS) Several studies in which the efficiency of different

TOXICITY OF SWASCOL (TRADE NAME) 1P (SLS) TO CHANNA PUNCTATUS AND CIRRHINA MRIGALA: BIOCHEMICAL ALTER-

ATIONS,
D. A. V. Coll., Muzaffarnagar (India). Pollution Relevant Research Lab.

S. R. Ve Dalela. Bulletin Toxicolo

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Identification Of Pollutants-Group 5A

S. R. Verma, N. Pal, A. K. Tyagi, and R. C. Dalela.

Bulletin of Environmental Contamination and Toxicology, Vol. 21, p 711-718, 1979. 3 tab, 29 ref.

Descriptors: *Toxicity, *Detergents, *Fish physiology, *Enzymes, *Channa, *Cirrhina, *Swascol, *Tissue analysis, Sulfates, Inhibition, Biochemistry, Animal metabolism, Chemical analysis, Mode of action, Chemical wastes, Anionic detergent.

Freshwater teleosts (Channa punctatus and Cirrhina mrigala) were exposed to the syndet Swascol IP with active matter sodium lauryl suphate (SLS), an anionic detergent, for 15 and 30 day time intervals. Following exposure the fish were sacrificed and the liver and kidney were analysed for enzyme activity of acid and alkaline phosphatases and succinic dehydrogenase. It was found that exposure inhibited enzyme activity. The response of acid and alkaline phosphatases were quite similar and dose dependent. Low exposure levels stimulated succinic dehydrogenase activity while high levels caused inhibition. Possible pathways for the actions of the chemical were also discussed. (Deal-EIS) EIS) W79-08677

EFFECT OF THERMAL EFFLUENTS AND RE-TENTION TIME ON LAKE FUNCTIONING AND ECOLOGICAL EFFICIENCIES IN PLANKTON COMMUNITIES, Polish Academy of Sciences, Warsaw. Inst. of

Ecology.

A. Hilbricht-Ilkowska, and B. Zdanowski.
Internationale Revue der gesamtem Hydrobiologie, Vol. 63, No. 5, p 609-617, 1978. 7 fig, 1 tab, 10 ref.

Descriptors: *Freshwater, Lakes, *Animal popula-tions, *Phytoplankton, Biomass, *Primary produc-tivity, Zooplankton, Cladocera, Water tempera-ture, Thermal pollution, Thermal power plant, Thermal stress, Cladocera, Komin Lake Complex, *Poland, On-site-investigation, Nutrients.

The following changes were observed in three lakes as a result of their heating and decrease of retention time (data for summer periods): increase of mixing rate, active bottom area, and nutrients, concentrations; significant changes in gross primary production, phytoplankton biomass and production of filtering cladocerans. These changes seem to indicate the higher efficiency of utilization of autochthonous trophic resources and energy transfer in plankton. There was a strong increase in the biomass of cladocerans. Lakes received the thermal effluent of powerplants. (Katz-EIS) W79-08678

EFFECT OF OXYGEN SUPPLY IN CONCRETE PONDS ON ENVIRONMENTAL FACTORS AND PRODUCTION OF FISH BY FEEDING (IN JAPANESE), Freshwater Fisheries Research Lab., Tokyo (Ispana).

(Japan). Y. Satomi, T. Maruyama, and Y. Furuta.
Bulletin of the Freshwater Fisheries Research Laboratory, Vol. 28, No. 2, p 169-187, 1978. 13 fig, 5 tab, 14 ref. (English summary).

Descriptors: *Oxygen requirements, *Fish farming, *Growth rates, Tilapia, Carp, Fish harvest, Water temperature, Dissolved oxygen, Nutrients, Nitrites, Weight, Carbon, Nitrogen, Phosphorus, Aquicul-

This study examined the effects of an artificial oxygen supply on fish production and the ecological dynamics in pond water. Identical ponds served as the experimental units. Carp and tilapia were stocked in each pond at rates of 44 kg and 19 kg per pond, respectively. An oxygen generator with a capacity of I cubic meter O2/hr was used. A device for mixing oxygen with water was installed in each pond. Water temperature, dissolved oxygen and transparency were monitored daily. The fish were harvested after four months. There were slight differences between the two ponds with regard to the seasonal fluctuation of abiotic and biotic factors. There were no fundamental

differences which would influence fish production, except the higher concentration of nitrite in the carp pond. The estimated carbon, nitrogen and phosphorus budgets in the ponds revealed significant low recovery of nitrogen and carbon. The amount unrecovered was larger in the carp pond than in the tilapia pond. At the end of the experiment, the increase of body weight was 3 kg and 2 kg/square meter or for carp and tilapia, respectively. The growth rate and feed efficiency of tilapia were superior to those of carp. It may be concluded from the results of this investigation that the oxygen supply in the ponds was very efficient in achieving higher fish production in spite of the higher concentration of nitrite in the water. (Deal-EIS) EIS) W79-08680

DETERMINATION OF TOTAL ORGANIC NITROGEN AND ORGANO-METALLIC NICKEL IN OIL, SEDIMENTS AND MARINE PROD-

Ociska Prefecture Inst. of Public Health (Japan). Lab. of Food Chemistry. A. Nakamura, and T. Kashimoto. Bulletin of Environmental Contamination and Toxicology, Vol. 22, p 345-349, 1979. 4 tab, 8 ref.

Descriptors: *Nickel, *Nitrogen compounds, *Oil, *Tissue analysis, Oil spills, Path of pollutants, Oil pollution, Chemical analysis, Gas chromatography, Clams, Bottom sediments, Benthic fauna, Analytical techniques, Oysters, Marine benthos.

The organometallic nickel and organic nitrogen compounds found in heavy oil are infrequently analyzed due to the need for sensitive detection equipment. This study utilized high pressure liquid chromatography and gas liquid chromatography with a nitrogen selective detector to analyze oil, sediments and marine products for the presence of these compounds. Data suggested that oil types have distinctive 'fingerprints' of nickel/nitrogen ratios which could be used to identify oil in sediments and marine biota after an oil spill organometallic nickel in various molluscs was determined. (Deal-EIS) (Deal-EIS) W79-08681

COMPARATIVE STUDY OF 85SR AND 90SR CONCENTRATION AND ELIMINATION IN CARASSIUS AURATUS GIBELIO, Department of Radiobiology, Bucharest (Roma-

III. Chiosila, and E. Reviu. Revue Roumaine de Biologie, Vol. 23, No. 2, p 125-128, 1978. 2 fig, 8 ref.

Descriptors: *Fish physiology, *Strontium radioisotopes, *Carassius, *Tissue analysis, *Elimination, Goldfish, Radiochemical analysis, Tracers, Absorption, Water chemistry, *Strontium, Food chains, Trophic level, Path of pollutants, 85Sr, 100c.

This paper presents several experiments concerning the concentration in Carassius auratus gibelio of 85Sr and 90Sr from contaminated waters with 1,200 pCi/ml. Concentration of the two radionuclides in fish, after a month's contamination, is almost identical, the concentration factors amounting to 10. The elimination of 85Sr and 90Sr from fish bodies takes place with the same Tb (136 days), while Te takes about 44 days for 85Sr and 136 days for 90Sr. (Deal-EIS)

HYDROCARBON POLLUTANTS FROM STATIONARY SOURCES, Radian Corp., Austin, TX. E. C. Cavanaugh, M. L. Owen, T. P. Nelson, J. R. Carroll, and J. D. Colley. Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 784, Price codes: A15 in paper copy. A01 in microfiche. Report EPA-600/7-77-110, 1977. 317 p. 22 fig. 63 tab, 131 ref, 1 append.

Descriptors: *Reviews, *Data collections. *Organic compounds, *Water pollution sources, *Agricul-

ture, Chemical industry, Industrial wastes, Oil in-dustry, Waste disposal, Waste water treatment.

dustry, Waste disposal, Waste water treatment. A review is presented of stationary sources of hydrocarbon pollutants which includes descriptions of major sources and estimates of the quantities emitted. Volatile emissions and effluents are considered. Fifty percent of the process organic effluents are from agricultural and forest products, and 47% are from chemical processing. Thirty-five percent of the remaining effluents are considered controlled with tertiary control of municipal waste water treatment facilities. The organic content of water effluents is estimated from information on BOD, COD, and TOC. The following sources are included: fossil fuel extraction; fossil fuel processing; fossil fuel transportation, marketing, and storage; fossil fuel refining; fossil fuel combustion organic chemical utilization; agricultural and forest products; natural sources; solid waste disposal; and municipal waste water treatment. (Small-FRC) W79-08741

EVALUATION OF LEACHATE TREATMENT VOLUME I, CHARACTERIZATION OF LEA-CHATE.

Illinois Univ. at Urbana-Champaign. Dept. of Civil

E. S. K. Chian, and F. B. DeWalle.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB-272 885,
Price codes: A11 in paper copy, A01 in microfiche.
Report EPA-600/2-77-186a, 1977. 225 p. 47 fig, 18
tab, 212 ref.

Descriptors: *Leachate, *Landfills, *Chemical analysis, *Organic compounds, *Membrane processes, Permselective membranes, Biodegradation, Metals, Waste water treatment, Municipal wastes.

Leachate from landfills located in various regions of the U.S. was analyzed for organics and inorganics as a preliminary to an evaluation of treatment alternatives. The separation of molecular weight fractions and the determination of primary classes of organics and functional groups was conducted with membrane ultrafiltration, gel-permeation chromatography, and specific organic analyses. Most of the organics were low molecular weight as evidenced by their ability to permeate a 500 molecular weight ultrafiltration membrane. Leachate samples exhibited a decrease of free volatile fatty acid fraction with increasing landfill age, as calculated from membrane fractionation and organic analyses. Sequential removal of organics from biological degradation studies followed the order of: high molecular weight humic carbohydrate-type organics; free volatile fatty acids; bacterially excreted carbonyl compounds and amino acids; and high molecular weight carbohydrates produced during the third phase. Most of the metals also permeated the membrane, indicating that chelation by refractory organics has a minor role in metal attenuation processes. Iron was an exception and was associated primarily with the 100,000 molecular weight retentate. Volume II contains results of bench-scale treatment process investigations. (Lisk-FRC) Leachate from landfills located in various regions

AREAWIDE ASSESSMENT PROCEDURES MANUAL VOLUME I, Environmental Protection Agency. Cincinnati.

OH. Available from the National Technical Information Service. Springfield. VA 22161 as PB-271 864. Price codes: A99 in paper copy. A01 in microfiche. Report EPA-600/9-76-014-1, 1976. 655 p. 86 fig. 84 tab, 216 ref. 10 append.

Descriptors: *Assessments, *Evaluation, *Publica-tions, *Analytical techniques, *Water pollution control, Water quality, Urban hydrology, City planning, Pollutant identification.

A summary is presented of available procedures and methodologies for the identification and esti-mation of pollutant load generation and transport from major sources within water quality manage-

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ment planning areas. The major emphasis is on the assessment of urban problems and the selection of alternatives in urban areas. There is some coverage of non-urban loads. Methodologies are also included for the assessment of present and future water quality impacts from major sources. There are also summaries of available information and techniques for the analysis of a selection of structural and non-structural control alternatives. This manual is destructural control alternatives. This manual is designed to present problem assessment and impact analysis approaches at several levels of planning. Simple procedures are recommended to develop understanding of the problem and to assist in the application of complex techniques. (See also W79-08798 and W79-08799) (Small-FRC) W79-08797

AREAWIDE ASSESSMENT PROCEDURES MANUAL VOLUME II, Environmental Protection Agency, Cincinnati,

Available from the National Technical Information Service, Springfield, VA 22161 as PB-271 865, Price codes: A07 in paper copy, A01 in microfiche. Report EPA-600/9-76-014-2, 1976. 129 p, 6 tab, 37

Descriptors: *Assessments, *Mathematical models, *Land use, *Data collections, City planning, Analytical techniques, Computer models, Statistics, Water quality, Water pollution sources.

Two appendices are presented for the Areawide Assessment Procedures Manual. The manual provides a guide to available procedures and methodologies for the identification and estimation of pollutant loads. Appendix A is the model applicability summary. Drainage models include STORM, SWMM, HSP, MICAT, HVM-QQS, Metcalf and Eddy, AGRUN, ILLUDAS, DOSAG-I, QUAL-II, RECEIV, RECEIV-II, SRMSCI, WRECEV, HWQM, and LAKECO. Appendix C is on land use data collection and analysis. A description is provided of a range of land use and demographic data collection, management, and analysis technical control of the cont data collection, management, and analysis techniques. Emphasis is on the identification of land use data needs, identification of existing data sources and characteristics, the matching of data needs with available data sources, and collection of land use data. (See also W79-08797) (Small-FRC) W79-08798

AREAWIDE ASSESSMENT PROCEDURES MANUAL, VOLUME III,

Environmental Protection Agency, Cincinnati,

Orl.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-271 866, Price codes: A99 in paper copy, A01 in microfiche. Report EPA-600/9-76-014-3, 1976. 590 p, 145 fig. 25 tab 2561 ref

Descriptors: *Assessments, *Storm water, *Urban runoff, *Overflow, *Water pollution control, Sewerage, Water quality, Water pollution control, Performance, Costs.

Appendices are presented for the Areawide As-sessment Procedures Manual. The manual provides a guide to available procedures and methodologies for the identification and estimation of pollutant loads. Appendix G is presented which deals with the performance and cost of urban stormwater management techniques. Part 2 of Appendix G is a paper initited Stormwater Management Model: Level 1, Comparative Evaluation of Storage-Treatment and Other Management Practices by James P. Heaney and Stephan J. Nix. This report describes simplified procedures which yield estimates of the magnitude of sewer overflows and stormwater discharges and the associated costs of control. Appendix H deals with point source control above the process of the control trol alternatives and their performance and cost. Extensive references are included. (See also W79-08797) (Small-FRC) W79-08799

TRACE METAL DISCHARGES OF THE GRAND CALUMET RIVER.

Purdue Univ., Lafayette, IN. Dept. of Bionucleon-

ics. R. R. Romano, A. W. McIntosh, W. V. Kessler, V. Anderson, and J. M. Bell. Journal of Great Lakes Research, Vol. 3, No. 1-2, p. 144-147, 1977. 1 fig, 4 tab, 10 ref. NSF-RANN

GI-35106.

Descriptors: *Grand Calumet River(IN IL), *Trace elements, *Heavy metals, *Lake Michigan, *Water pollution sources, *Pollutants, *Industrial wastes, *Municipal wastes, Rivers, Canals, Indiana Harbor Canal(IN), Chicago(IL), Indiana, Illinois, Great Lakes, Lakes, Cadmium, Iron, Zinc, Lead, Sediments, Water supply, Path of pollutants, On-site investigations. site investigations

The Grand Calumet River system is a major fluvial source of heavy metals to Lake Michigan through its outlet, the Indiana Harbor Canal. Sampling conducted at three bridge sites on the river's western and eastern arms and on the canal from November 1974-October 1975 showed that levels of cadmium, lead, zinc, and iron in sediments generally exceed values reported in the literature for other polluted systems, while levels in water are less elevated. Total metal discharge from the river exhibits the following descending order: Fe Zn Pb Cd. Significant amounts of the filterable lead fraction (about 10 tons/yr) are discharged through the tion (about 10 tons/yr) are discharged through the canal. Even if industrial and municipal sources of trace metals were controlled throughout the system, current metal loads in the Grand Calumet River might threaten water quality in Lake Michigan's southern basin (especially in the Chicago area) for many years. Several cities use the lake as a source of drinking water. Eight major industries a source of criming water. Eight major industrial and three large municipal sewage treatment plants located along the river and canal contribute trace metals. Weighted averages of sediment concentrations for the three sites are 5.5 ppm dry wt for cadmium (range 3.13-7.85), 545 ppm for lead (208-811), 1390 for zinc (750-2060), and 42,000 for iron 011), 1390 for zinc (750-2000), and 42,000 for fron (27,000-61,900). In water weighted average con-centrations are 1.0 ppb for cadmium (0.8-1.3), 23 ppb for lead (16-29), 70 ppb for zinc (57-80), and 1090 ppb for iron (750-1540). (Lynch-Wisconsin) W79-08813

TRACE ELEMENTS IN SAMPLES OF FISH, SEDIMENT AND TACONITE FROM LAKE SU-

PERIOR,
Wisconsin Univ.-Madison. Dept. of Chemistry.
R. J. Korda, T. E. Henzler, P. A. Helmke, M. M.
Jimenez, and L. A. Haskin.
Journal of Great Lakes Research, Vol. 3, No. 1-2,
p. 148-154, 1977. 1 fig., 2 tab, 18 ref. NSF-RANN

p 148-154, GR-29731.

Descriptors: *Taconite, *Fish, *Sediments, *Lake Superior, *Sculpin, *Trace elements, Great Lakes, Lakes, Cottus cognatus, Myoxocephalus quadri-cornis, Copper, Zinc, Manganese, Sodium, Ar-senic, Mercury, Cobalt, Scandium, Cadmium, Selenium, Rare-earth elements, Tracers, Water pollu-tion sources, Path of pollutants, Water pollution effects, Sediment-water interfaces, Minnesota, Silver Bay(MN), Tofte(MN), On-site investiga-

Neutron activation analysis of 27 trace elements in sculpin, sediment, and taconite tailings taken Sep-tember 1972 from areas of Lake Superior with high and low concentrations of taconite tailings indicate that the presence of taconite does not significantly affect trace element concentrations in sculpin. Concentrations of all elements except manganese and arsenic are lower in tailings than in sediment, and concentrations of trace elements in the fish are similar between contaminated and control sites Manganese and arsenic levels are five times higher in taconite than sediment. Samples were collected:
(1) 10 km offshore from Silver Bay, Minnesota, where the bottom is covered by about four cm of taconite tailings, (sampling at depths of 180-250 m); and (2) at Tofte, Minnesota, about 130 km north of Silver Bay where only traces of taconite have been found. Flesh and livers samples of two sculpin species were tested, slimy sculpin (Cottus cogna-tus) and four-horned sculpin (Myoxocephalus qadricornis). Sculpin live and feed exclusively at the sediment-water interface. Elements analyzed were copper, zinc. manganese, sodium, arsenic, mercury,

cobalt, scandium, cadmium, selenium, and the rare-earth elements. Low concentrations of most trace elements in taconite and similarity of their concen-tration ratios indicates that no elements measured in taconite are suitable tracers for taconite move-ment and distribution in Lake Superior. Possible sources of contamination of fish tissue samples are discussed. (Lynch-Wisconsin) W79-08814

DEHYDROABIETIC ACID ACCUMULATION BY RAINBOW TROUT (SALMO GAIRDNERI) EXPOSED TO KRAFT MILL EFFLUENT, Canada Centre for Inland Waters, Burlington (On-

M. E. Fox, D. M. Whittle, and K. L. E. Kaiser. Journal of Great Lakes Research, Vol. 3, No. 1-2, p 155-158, 1977. 1 fig, 1 tab, 16 ref.

Descriptors: *Rainbow trout, *Kraft mills, *Water pollution effects, *Dehydroabietic acid, *Bioaccumulation, *Fishkill, Salmo gairdneri, Pulp and paper industry, Lake Superior, Great Lakes, Nipigon Bay(Ontario-Canada), Ontario(Canada), Canada, Bays, Toxicity, Resin acids, Effluents, Idustrial wastes, Sublethal effects, Water pollution sources, Poisons, Bioassay, Chromatography.

Rainbow trout (Salmo gairdneri) exposed to kraft mill effluent under laboratory conditions accumulate dehydroabietic acid (DHA) to a level likely to result in sublethal toxic effects. DHA is a resin acid constituent of pulp mill effluents derived from coniferous trees, known to be toxic to fish at mg/l constituent of pulp mill effluents derived from coniferous trees, known to be toxic to fish at mg/l concentrations and to persist in water and sediments. The upper Great Lakes are affected by pulp and paper mill effluents at several locations, and in some receiving waters fish populations have undergone drastic changes. Yearling rainbow trout of about 200 g each were obtained from a trout farm and acclimated two weeks to water of Nipigon Bay (northern Lake Superior), which has ph 7.8 and EDTA hardness 69 mg CaCO3/l. Duplicate populations of 10 fish each were exposed to bleached kraft mill effluent concentrations of 18, 10, 6, and 3% V/V for 48-144 hrs on a continuous-flow basis. Whole fish were homogenized by grinding and analyzed for DHA. Levels of 2-10 mu-g DHA/g were found in the fih on a whole weight basis. Less than one mu-g DHA/g was found in control fish also acclimated in Nipigon Bay water for two weeks, and no residue was detected in an unexposed fish. Fish exposed to 3% effluent for 144 hrs accumulated less DHA than those exposed to higher concentrations for shorter periods. The mean concentration of DHA in the last kert first lefficient left first left was about periods. The mean concentration of DHA in the final kraft mill effluent used in the study was about 3.7 mg/l, and with the dilutions fish were exposed to levels of 0.1-0.7 mg/l, toxic to salmonid fish species. (Lynch-Wisconsin) W79-08815

FORMS AND SEDIMENT ASSOCIATIONS OF NUTRIENTS (C.N. AND P.) PESTICIDES AND METALS, NUTRIENTS - P, For primary bibliographic entry see Field 5C. W79-08828

ANTHROPOGENIC INFLUENCES OF SEDI-MENT QUALITY AT A SOURCE, NUTRIENTS: CARBON, NITROGEN AND PHOSPHORUS, bibliographic entry see Field 5C

5B. Sources Of Pollution

HEAVY METAL ENRICHMENT IN MINE DRAINAGE: IV. THE ORANGE FREE STATE GOLDFIELD.

GOLDFIELD,
Pretoria Univ. (South Africa). Dept. of Chemistry.
G. T. Wittmann, and U. Foerstner.
South African Journal of Science, Vol. 73, No. 12, p 374-378, December 1977. 1 fig, 6 tab, 32 ref.

Descriptors: *Mine water, *Heavy metals, *Acid mine drainage, Acid mine water. Mine acids, Mine drainage. Water pollution sources. Water quality, Toxins, Chemical wastes. Gold, Uranium. South

The hear from gold examined fossil wardisposed or slimes undergrounders a sev of sampl water sai sites of h ing of sli along the Free Sta industry ble and r environm metals w In setting cial impo which ar because dinclude the heavy r (Schaefer W79-085

> For prin W79-085 ESTUAR For primary W79-0854

> DESIGN PLICATI North C Biologica

APPLICA DIMENS Rutgers-Chemical J. S. Wu, Water Re 670, June

Descripto Rivers, Biochemi Dissolved flow, Wa Pollutants ments, Su stead

model has

ations of nitrogen, branched ed waste under aer For anaer oxygen a tion and contributi impact an tions, dur ed by sto proach st ISWS) W79-0856

WATER ATIONAL California mental Sc R. L. Peri Water Re 627, June

pollution tersheds. I Benthos, solids, Wase, *Sierr al Forest(

Descripto

Sources Of Pollution—Group 5B

The heavy metal content of acid mine drainage from gold and uranium recovery in South Africa is examined. Enormous volumes of brackish saline fossil water as well as mining effluents are chiefly disposed of by pumping them to evaporation dams or slimes retention dams. The high salinity of the underground water corrodes mining gear and also has a severe ecological impact. During two periods of sampling, 17 sediment and 14 corresponding water samples were collected to determine critical sites of heavy metal enrichment. In situ acid leaching of slimes residues occurred from tailings areas along the gold/uranium mining periphery of the Witwatersrand Basin. Results from the Orange Free State goldfield also imply that the mining industry is suffering economic losses due to valuable and recoverable metal being discharged to the environment. Standards must be set for toxic metals without them: lead, cadmium, and mercury. In setting criteria for assessing water quality, special importance must be attached to those elements which are both very toxic and relatively accessible because of their biological impact. These elements include the nonmetals arsenic and selenium and the heavy metals mercury, cadmium, and lead. (Schaefer-IPA) W79-08525 he rareconcen-neasured ples are

LATION DNERI) ton (On-No. 1-2,

, *Water Bioaccuulp and tes, Nipi-Canada), pollution hy.

to kraft accumu-likely to resin acid h at mg/l and sedi-d by pulp ns, and in ve under-trout of

rout farm
f Nipigon
as pH 7.8
Duplicate
sposed to
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ontinuousnized by ls of 2-10 is of 2-10 is a whole IA/g was in Nipigon sidue was sed to 3% OHA than

or shorter was about re exposed nonid fish

d SC.

OF SEDI-ORUS, d SC

IN MINE Chemistry.

ab. 32 ref. tals, *Acid acids, Mine ter quality.

73, No. 12,

A steady-state, one-dimensional water quality model has been formulated to evaluate spatial variations of biochemical oxygen demand, ammonia nitrogen, and dissolved oxygen for nontidal, branched river systems, with point sources of treated wastes and uniform nonpoint-source loads, under aerobic and/or anaerobic stream conditions. For an_erobic conditions, the decay rate of organic matter was assumed to be limited by the rate of oxygen addition to the streams via stream reaeration and net algal photosynthesis and respiration contributions. The model is applicable to stream impact analysis under sustained wet weather conditions, during which storm-runoff loads are generated by storms of sufficiently long duration to approach steady state in the river system. (Sims-ISWS) TONS OF DES AND

WATER QUALITY IN MOUNTAIN RECREATIONAL AREAS, California Univ., tos Angeles, Office of Environmental Science and Engineering. R. L. Perrine, and R. A. Mah. Water Resources Bulletin, Vol. 15, No. 3, p 612-627, June 1979. 5 fig, 4 tab, 31 ref. NSF GZ2269.

DESIGN FOR PRETREATMENT - LAND AP-PLICATION OF INDUSTRIAL WASTES, North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering. For primary bibliographic entry see Field 5D. W79-08526

ESTUARINE PROCESSES, VOLUME I AND II. For primary bibliographic entry see Field 2L. W79-08543

APPLICATIONS OF A STEADY-STATE, ONE-DIMENSIONAL WATER QUALITY MODEL, Rutgers-The State Univ., Piscataway, NJ. Dept. of Chemical and Biochemical Engineering. J. S. Wu, and R. C. Ahlert. Water Resources Bulletin, Vol. 15, No. 3, p 660-670, June 1979. 3 fig. 2 tab, 4 ref.

Descriptors: "Water quality, "Storm runoff, "Rivers, "Model studies, Mathematical models, Blochemical oxygen demand, Nitrogen, Ammonia, Dissolved oxygen, Anaerobic conditions, Steady flow, Water pollution, Water pollution sources, Pollutants, Path of pollutants, Scouring, Sediments, Suspended solids, Streamflow.

Descriptors: *Water quality, *Recreation, *Water pollution sources, *California, Forests, Forest watersheds, Recreation wastes, Pollutants, Mountains, Streams, Lakes, Nutrients, Bacteria, Coliforms, Benthos, Chemicals, Dissolved oxygen, Dissolved solids, Water temperature, Water pollution, Land see, *Sierra Nevada, *Owens River, *Inyo National Forest(CA), *Bishop Creek(CA).

Several scasons of water quality study in the eastern Sierra Nevada have provided much useful information. One study element focused in detail on a representative drainage: Bishop Creek, from sampled locations at 12,800 feet to the Owens River at 4,000 feet. Substudies ranged from geohydrology, through chemical and bacterial quality, to benther scology. A coordinated study, also uses drology, through chemical and bacterial quality, to benthic ecology. A coordinated study also was made of spatial patterns of use. A second element focused on non-point source monitoring the length of the Inyo National Forest. From physical, chemical, and bacterial standpoints, water quality was generally very good. Strains of pathogenic bacteria were confirmed, and substantial further work to were confirmed, and substantial further work to establish the importance of their presence is needed. Recreational use survey results were analyzed to produce a methodology permitting management of the resource as needed. In addition, basic policy recommendations to easily minimize risk were developed. (Sims-ISWS) W79-08580

THE QUESTION OF NITRIFICATION IN THE PASSAIC RIVER, NEW JERSEY: ANALYSIS OF HISTORICAL DATA AND EXPERIMENTAL INVESTIGATION, New Brunswick, NJ. Dept. of Environmental Science. For primary bibliographic entry see Field 5A. W79-08582

WATER QUALITY GUIDELINES FOR ACID MINE DRAINAGE AND STRIP MINE AREAS

IN 10WA, Energy and Mineral Resources Research Inst., Ames, IA. Dept. of Animal Ecology. T. P. Nesler, and R. W. Bachmann. Available from the National Technical Information

Service, Springfield, VA 22161 as IS-ICP-56, Price codes: A09 in paper copy, A01 in microfiche. Report, February 1977. 177 p, 10 fig, 15 tab, 243 ref, 2 append.

Descriptors: *Strip mines, *Water quality, *Acid mine water, *Water pollution sources, *Iowa, Water pollution, Water pollution effects, Strip mine wastes, Mine wastes, Mine acids, Coal mine wastes, Coal mines, Reviews, On-site investigations, Sampling, Chemical analysis, Chemicals, Pollutants, Erosion, Sediments, Water quality control, Water pollution, control. trol, Water pollution control.

Extensive literature compilation and investigation of state-of-the-art reclamation in four states contiguous to Iowa were conducted to review (1) the impact of coal mining upon water quality, (2) the reclamation technique utilized in countering the adverse effects of acid mine drainage, and (3) the problems encountered in water quality management of strip-mined lands. Field analyses in strip-mine areas of Iowa have demonstrated similar degradation of water quality due to acid mine drainage. Distributions of alkalinity, specific conductance, sulfate, and total iron in the streams with watersheds affected by mining were significantly different than those determined for the control streams, according to Chi-square analysis. The water quality reflected by the results is expected to worsen with expanding coal-mining activity in Iowa unless effective reclamation accompanies this expansion. From the literature and experience base of other effective reclamation accompanies this expansion. From the literature and experience base of other coal-mining states, certain techniques are considered essential in maintaining a suitable water quality in strip-mine areas. Segregation of acidic and nonacidic cast overburden, isolation and deep burial of spoil and mine wastes, hydrologic isolation of mine and coal processing areas, landscape stabilization through grading and revegetation, and cover or neutralization of abandoned strip-mine areas are the primary elements of successful re-gional reclamation and rehabilitation efforts. These efforts may be aided by adequate premining analy-sis of mining impacts and planning of reclamation activity suitable to land use potential. (Sims-ISWS) W79-08611

A VERIFICATION OF THE QUAL-1 WATER QUALITY MODEL FOR THE LOWER MISSIS-

SIPPI RIVER, Texas Univ. at Arlington. Dept. of Computer Sci-

ence and Engineering. T. M. Sparr. Water Resources Bulletin, Vol. 15, No. 3, p 853-860, June 1979. 7 fig. 7 ref.

Descriptors: *Water quality, *Mississippi River, *Model studies, Mathematical models, Dye re-leases, Dispersion, Diffusion, Pollutants, Path of pollutants, Water pollution, Rivers, Analytical techniques.

This paper described the verification of the QUAL-1 mass transport model for the lower Mississippi River between St. Francisville and Point a la Hache using dye studies conducted by the U.S. Geological Survey. QUAL-1 is a one-dimensional, steady-state model for rivers and is capable of predicting longitudinal profiles of soluble materials entering rivers from point sources. Both conservative and processory rative and processory. tive and nonconservative parameters of water quality can be considered. The major problems surmounted were the determination of a diffusion coefficient and the use of transient data to verify a steady-state model. (Sims-ISWS) W79-08616

RATE OF AVAILABILITY OF TOTAL PHOS-PHORUS IN RIVER WATERS, West Virginia Univ., Morgantown. Dept. of Chemical Engineering. F. H. Vehoff, and M. R. Heffner. Environmental Science and Technology, Vol. 13, No. 7, p 844-849, July 1979. 2 fig, 5 tab, 15 ref.

Descriptors: *Phosphorus, *Rivers, *Lake Erie, *Great Lakes, *Algae, Sampling, Chemicals, Nitrates, Nitrites, Dissolved oxygen, Hydrogen ion concentration, Suspended solids, Harvesting of algae, Water pollution, Water pollution sources, Pollutants.

During storm events, large quantities of total phosphorus (dissolved, particulate, and adsorbed) are transported into Lake Erie from its tributaries. The effect of this phosphorus on the lake ecosystem depends upon the availability of this phosphorus for biological growth. In this paper, a variation of the algal assay procedure bottle test was used to determine the conversion rate of total phosphorus to an available form. The rate of conversion measured using indigenous microorganisms was less ured using indigenous microorganisms was less than 0.40% per day. This rate compared favorably with other experimental and theoretical informa-tion in the literature. (Sims-ISWS) W79-08626

LEACHING ASPECTS OF OIL SLUDGE BIO-DEGRADATION IN SOIL, Rutgers--The State Univ., New Brunswick, NJ. Dept. of Biochemistry and Microbiology. For primary bibliographic entry see Field 5E. W79-08629

ADVANCES IN GROUNDWATER HYDROL-

OGY.
For primary bibliographic entry see Field 2F.
W79-08631

NUMERICAL SIMULATION OF CONTAMINANT TRANSPORT IN SUBSURFACE SYSTEMS,

California Univ., Davis. Dept. of Land, Air and

M. A. Marino.

In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 113-129, September 1976. 5 fig. 34

Descriptors: *Groundwater movement, *Wastes, *Simulation analysis, *Model studies, Mathematical models, Numerical analysis, Recharge, Flow, Equations, Aquifers, Analytical techniques, Finite element analysis, Dispersion, Groundwater, Aquifer systems, Water levels, Water table, Pollutants, Spatial distribution, Surface-groundwater relationships.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B-Sources Of Pollution

This paper investigated the effects of possibly con-Inis paper investigated the effects of possibly con-taminated recharge effluent on the quality and quantity of groundwater supplies. Emphasis was given to the possible contamination of ground-water in the region beneath and in the proximity of the recharge site. The pollutants of concern are conservative substances, i.e., dissolved chemical substances which remain unaltered during the transport process. Numerical simulation of contaminant transport in subsurface systems involves the simultaneous or sequential solution of the flow and mass transport equations subject to appropriate initial and boundary conditions. Both finite difference and finite element techniques have been used to solve these equations. A two-dimensional finite element model was presented that simulates the movement and depth distribution of a dissolved chemical substance in a recharged stream-aquifer system. Numerical examples that illustrate the applicability of the model were presented. (See also W79-08631) (Humphreys-ISWS) W79-08641

THE FINITE ELEMENT METHOD IN GROUNDWATER TRANSPORT,
Princeton Univ., NJ. Dept. of Civil Engineering.

W. G. Gray.

In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St.

Descriptors: *Groundwater movement, *Math-Descriptors: "Groundwater movement, Man-ematical models, "Finite element analysis, "Re-views, Water pollution, Model studies, Analytical techniques, Dispersion, Convection, Equations, Groundwater.

Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 130-143, September 1976. 46 ref.

This paper was a literature review of the use of the finite element method in modeling contaminant transport in groundwater. Alternative formulations of the procedure, analyses of the behavior of finite element solutions, and various field applications prove the efficiency of existing schemes and to further reduce the dissipative and dispersive errors generated. (See also W79-08631) (Humphreys-ISWS) were discussed. Further research is needed to im-W79-08642

CHEMICAL ASPECTS OF PRESENT AND FUTURE HYDROGEOLOGIC PROBLEMS, Geological Survey, Reston, VA. Water Resources Div.; and Waterloo Univ. (Ontario).

W. Back, and J. A. Cherry. In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 153-172, September 1976. 1 fig.

Descriptors: *Geochemistry, *Water quality, *Ion exchange, *Mass transfer, *Water temperature, Ion transport, Groundwater movement, Organic compounds, Aquitards, Path of pollutants, Reviews.

Low temperature aqueous geochemistry has made continuous contributions to the understanding of groundwater systems during the past 20 years primarily by use of the law of mass action, mass balance relationships, and isotopes. Hydrologic and groundwater quality problems associated with social and economic issues demand an expanded effort in application of principles of geochemistry. These efforts require a geochemical evaluation of the transfer term in the transport equation in order to construct predictive models for natural and contaminated systems. This additional understanding will be gained by expanding our efforts to include aquitards and the unsaturated zone rather than the almost exclusive focus on aquifers and the saturated zone that has been so common in the past, by incorporating principles from other disciplines, and by changing scale in both time and space. Along the path leading towards the development of useful predictive transport models for nonconservative constituents, there loom many problems, including the acquisition of adequate data on geology, chemical mechanisms and kinetics, bacteria, organ-

ic compounds, and the transferability of data be-tween laboratory and field systems. A review of the recent literature indicates that work has begun on many of these problems. (See also W79-08631) (Woodard-USGS) W79-08644

DISPERSION IN NON-UNIFORM AND ANI-SOTROPIC POROUS MEDIA,

Shell Development Co., Houston, TX.
For primary bibliographic entry see Field 2F.

IDENTIFICATION OF GEOCHEMICAL PAT-TERNS IN GROUNDWATER BY NUMERICAL

Suwannee River Water Management District, White Springs, FL.
F. W. Lawrence, and S. B. Upchurch.

In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 199-214, September 1976. 7 fig, 3 lie Min

Descriptors: *Water quality, *Hydrogeology, *Groundwater, *Florida, Numerical analysis, Onsite investigations, Analytical techniques, Calcium, Hardness(Water), Alkalinity, Silica, Magnesium, Fluorides, Phosphorus, Sampling, Chemical properties, Aquifers, Variability, Water wells, Water properties, *Floridan aquifer, Hydrochemical

A total of 152 water wells, completed at similar horizons in the upper Floridan Aquifer, in a four township area around Lake City, Florida, were analyzed for 15 chemical variables. R-mode factor analysis was used to identify those variables that reflect areally significant recharge processes. Of the 15 variables, 9 convey significant information and cluster into 3 groups. Factor 1, which includes calcium, hardness, alkalinity and specific conduc-tivity, reflects waters that have been in contact with the limestones and dolomites of the Floridan Aquifer for the longest period and approach equili-bration with those strata. Factor 2, which includes silica, magnesium, and fluoride, represents resilica, magnesium, and fluoride, represents re-charge waters percolating through the clastics overlying the Floridan. Factor 3, which includes only phosphorus, represents recharge water de-rived by direct connection with the surface in the area of sinkhole lakes. This study showed that factor analysis is useful in interpreting raw chemi-cal data and in relating those data to specific hydrogeologic processes. Practical applications of this technique include water use and water re-source management. Uses for the technique in-clude: (1) determining the real or predicted extent source management. Uses for the technique include: (1) determining the real or predicted extent and degree of contamination from recharge events, (2) identifying areas where water quality may limit water use, (3) delineating areas where activities such as land disposal of wastes, artificial recharge and excessive pumping may have an impact on water quality or quantity, and (4) identifying zones of potentially higher well yields. (See also W79-08631) (Humphreys-ISWS) W79-08647

MIGRATION OF LANDFILL LEACHATE THROUGH UNCONSOLIDATED POROUS THROUGH MEDIA.

MEDIA, Illinois State Geological Survey, Urbana. K. Cartwright, R. A. Griffin, and R. H. Gilkeson. In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 215-227, September 1976. 4 fig, 3 tab, 13 ref. EPA 68-03-0211.

Descriptors: *Landfills, *Leachate, *Groundwater, *Water pollution sources, *Illinois, On-site investigations, Laboratory tests, Sampling, Movement, Analysis, Heavy metals, Porous media, Flow, Polutants, Hydraulic conductivity, Percolation, Attenuation, Chlorides, Sodium, Potassium, Lead, Cadmium, Water properties, *DuPage County(IL).

Leachate was collected by anaerobic techniques from the 15-year-old DuPage County sanitary landfill near Chicago, Illinois, and passed through 44 laboratory columns that contained various mixtures of calcium-saturated clays and washed quartz sand. The columns were constructed to simulate the columns were constructed an expense of the columns were constructed to simulate the columns were construc said. The columns were constructed to simulate slow, saturated anaerobic flow, and manometers were placed at 5 locations in each column to measure any hydraulic conductivity changes. Leachates were run through the columns for periods of up to 10 months, during which time effluents were periodically collected and analyzed for 21 were periodically collected and analyzed for 21 chemical constituents. Chloride and certain organics were relatively unattenuated by passage through the clay columns; monovalent cations such as Na, K, and NH4, were moderately attenuated; and heavy metals, such as Pb, Cd, and Zn, were attenuated by even small amounts of clay. Concentrations of Ca and Fe in the column effluents increased markedly over the original refuse leachate concentrations as a result of cation exchange and from a reduction of the oxidized Fe on clay surfaces. Both biologically active and sterilized leachate reduced the hydraulic conductivity during the experiment. The active leachate reduced the hydraulic conductivity to a much greater degree than the sterile leachate. Results of the laboratory data were checked at the DuPage County sanitary landfill and other existing landfills where detailed field data are available. These field data showed a 'hardness halo' corresponding to the Ca release in the columns. The relative attenuation rates of some of the ions were also confirmed by the field data. The change in hydraulic conductivity was not as clearly shown. (See also W79-08631) (Humphreys-ISWS) change and from a reduction of the oxidized Fe on

THEORETICAL DEVELOPMENTS AND PRACTICAL NEEDS IN THE FIELD OF SALT WATER INTRUSION, THEORETICAL

North Carolina State Univ. at Raleigh. Dept. of Civil Engineering. A-A. I. Kashef.

A-A. I. Kasnet.
In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 228-242, September 1976. 10 ref.

Descriptors: *Aquifers, *Saline water intrusion, *Water management(Applied), *Reviews, Coasts, Dispersion, Diffusion, Porous media, Analytical techniques, Groundwater, Control, Saline water freshwater interfaces, Mathematical models, Hydraulic models, Saline water barriers, Coastal

During the last two decades, extensive work in the field of salt water intrusion in coastal aquifers has been done. Most of the well-established theories treated the location of the salt-freshwater interface assuming immiscible fluids. Extensive theoretical developments in the analysis of dispersion been made recently, but not as yet to the satisfac-tion of the water resources managers who are seeking practical guidelines for the control of salt water intrusion. The urgent needs for water supply in some areas dictated the application of costly trial and error control methods. An attempt was made in this paper to review the advances in the theoretical developments in order to pinpoint the practical needs in this field. (See also W79-08631) (Humphreys-ISWS) W79-08649

DETERMINATION OF PENTACHLORO-PHENOL IN MARINE BIOTA AND SEA WATER BY GAS-LIQUID CHROMATO-GRAPHY AND HIGH-PRESSURE LIQUID CHROMATOGRAPHY, CANTER DESCRIPTION

Environmental Research Services, Gulf Breeze, For primary bibliographic entry see Field 5A.

THE WEST FALMOUTH OIL SPILL: HYDRO-CARBONS IN THE SALT MARSH ECOSYS-Victoria Ministry for Conservation, Melbourne

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TIGER SYSTEM Michiga Wolf La For prin W79-086

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Sources Of Pollution—Group 5B

For primary bibliographic entry see Field 5A. W79-08666

CHANGES IN THE PHYTOPLANKTON OF AN ENGLISH LAKE, 1945-1977, Freshwater Biological Association Ambleside

rresuwater Biological Association Ambleside (England).
J. W. G. Lund.
High cobiological Journal, Vol. 14, p 6-21, 1978. 9 fig. 5 tab. 23 ref.

Descriptors: *Phytoplankton, *Sewage, England, *English Lake District, Water quality, Nutrients, *Eutrophication, Algae, Laboratory tests, On-site-investigations, Phosphorous compounds, Silicants, Nitrogen, *Blelham Tarn, Agricultural chemicals, Agricultural runoff.

Agricultural runoff.

The phytoplankton of a small lake in the English Lake District has been sampled and the lake water analyzed on a weekly basis since 1945. Changes in the amount and nature of the sewage entering it and improvements in farming have led to increased algal abundance. The phytoplankton now contains several new species characteristics of eutrophic lakes, none of which was seen before 1954. Observation and analysis have been combined with a variety of experiments designed to elucidate the main factors determine these quantitative and qualitative changes. They also suggest possible future algal changes if eutrophication continues. Some examples are given with special reference to the use of large enclosures in the lake. These enclosures permit experiments on natural populations. The major nutrient limiting algal growth is phosphorus. Silicon and organic complexes, notably with iron, are also important. Nitrogen was of minor importance until recently, presumably because the increased supply of phosphorus, and consequent larger algal populations have led to greater demands for nitrogen. (Katz-EIS)

AIR-POWERED STREAM TANK FOR LABORATORY USE,
Toronto Univ., (Ontario). Div. of Life Sciences.
D. D. Williams.
The Progressive Fish-Culturist, Vol. 41, No. 2, p
88-89, 1979. 2 fig, 1 ref.

Descriptors: *Research equipment, *Aquaria, Methodology, Laboratory equipment, Bioassay, Equipment, Analytical techniques, Currents(Water), Streamflow, Laboratory tests, Aquiculture, Aquatic insects, Benthos.

Small laboratory stream tanks are commonly used in bioassay work and behavioral studies, and as culturing and holding facilities for fishes and invertebrates. This paper presents the details of a stream-tank system and the apparatus devised to power it with compressed air. The apparatus consists of a double-walled stream tank with an attached paddle wheel. The variable-speed paddle wheel is driven by compressed air, an advantage over electric motors in terms of cost. The tank has been used successfully to study the effects of silt on been used successfully to study the effects of silt on various species of aquatic insects and macrocrusta-ceans. (Deal-EIS) W79-08669

LEAD ACCUMULATION IN AQUATIC PLANTS FROM METALLIC SOURCES IN-CLUDING SHOT, Montana Univ., MO. Dept. of Botany. For primary bibliographic entry see Field 5A. W79-08670

EXPERIMENTAL INTENSIVE CULTURE OF TIGER MUSKELLUNGE IN A WATER REUSE SYSTEM, Michigan Dept. of Natural Resources, Mattawan. Wolf Lake State Fish Hatchery. For primary bibliographic entry see Field 5A. W79-08672

DETERMINATION OF TRACE ELEMENTS IN MARINE ORGANISMS-II RELATIONSHIP BE-

TWEEN THE BODY SIZE OF SARGASSUM HORNERI AND CONCENTRATION OF IRON (IN JAPANESE),
National Inst. of Radiological Sciences, Nakaminato (Japan). Marine Radio-Ecological Research Station.

For primary bibliographic entry see Field 5A. W79-08673

HEAVY METAL CONTENTS IN DEEP-SEA FISHES (IN JAPANESE), Tokyo Univ. of Fisheries (Japan). Lab. of Food Hygienic Chemistry.

For primary bibliographic entry see Field 5A. W79-08674

SUCCESSION OF AQUATIC INSECTS CAUSED BY MILD ORGANIC POLLUTION IN RIVERS (IN JAPANESE), Freshwater Fisheries Lab., Tokyo (Japan). For primary bibliographic entry see Field 5C. W79-08679

DETERMINATION OF TOTAL ORGANIC NITROGEN AND ORGANO-METALLIC NICKEL IN OIL, SEDIMENTS AND MARINE PROD-

Ocaska Prefecture Inst. of Public Health (Japan). Lab. of Food Chemistry. For primary bibliographic entry see Field 5A. W79-08681

COMPARATIVE STUDY OF 85SR AND 90SR CONCENTRATION AND ELIMINATION IN CARASSIUS AURATUS GIBELIO,

Department of Radiobiology, Bucharest (Romania).

For primary bibliographic entry see Field 5A. W79-08682

PESTICIDE AND PCB OF COMMON EIDER, HERRING GULL AND GREAT BLACK-BACKED GULL EGGS, Fish and Wildlife Service, Laurel, MD. Patuxent Wildlife Research Center.
R. C. Szaro, N. C. Coon, and E. Kolbe.
Bulletin of Environmental Contamination and Toxicology, Vol. 22, p 394-399, 1979. 2 tab, 17 ref.

Descriptors: *Pesticide residues, *Polychlorinated biphenyls, *Bird eggs, *Tissue analysis, *Bioaccumulation, *Kepone, DDT, DDE, DDD, Dieldrin, Heptachlor, Chlorinated hydrocarbon pesticides, Gulls, Common Eider duck, Path of pollutants, Maine, Virginia.

The eggs of Herring Gull, Black-backed Gull, and Common Eider from Maine and Herring Gull from Virginia were analyzed for pesticide and PCB residues. All but one Common Eider egg contained detectable residues of DDE. PCBs were detected in all eggs. Levels of both DDE and PCBs were low. No other organochlorine compounds were detected. There were no significant differences in the residue levels of DDT and its metabolites or PCBs in the Herring Gull eggs collected in Maine and Virginia. However, all were significantly greater than the residues in Common Eider eggs. The six Herring Gull eggs from Virginia did not contain detectable levels of Kepone. Great Blackbacked Gull eggs contained significantly more DDE and PCBs than Herring Gull eggs from either Maine or Virginia. In additions, low levels of several other pesticides were detected in Great Black-backed Gull eggs. (Deal-EIS)

HUMAN WASTE DISPOSAL ON BEACHES OF THE COLORADO RIVER IN GRAND CANYON,

Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 5D.
W79-08722

MOVEMENT OF SELECTED METALS, ASBESTOS, AND CYANIDE IN SOILS: APPLICATIONS TO WASTE DISPOSAL PROBLEMS, Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.

W. H. Fuller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-266 905, Price codes: A12 in paper copy. A01 in microfiche. Report EPA-600/2-77-020, 1977. 242 p, 40 fig. 43 tab, 330 ref, 2 append.

Descriptors: *Waste disposal, *Leachate, *Soil me-chanics, *Landfills, *Heavy metals, Asbestos, Ar-senic compounds, Design criteria, Movement, Mi-gration, Municipal wastes.

The movement of certain hazardous substances in soils at land disposal sites is discussed. The selected hazardous materials investigated included wastes containing arsenic, asbestos, beryllium, cadmium, chromium, copper, cyanide, iron, lead, mercury, selenium, and zinc. Data on hazardous material movement in soils was obtained from previous literature and from laboratory studies of municipal landfill leachate movement. Soil and waste considerations in the selection and management of disposal sites for minimum movement of hazardous materials are reviewed and data on soils, geological materials, and the chemistry of selected hazardous materials relevant to their migration in soils is included. The properties of mixtures of hazardous materials and the effects of high concentrations of other organic and inorganic solutes on the wastes are discussed. (Lisk-FRC) W79-08746

INACTIVATION OF ENTERIC BACTERIA AND VIRUSES IN SANITARY LANDFILL LEA-

CHATE, Illinois Univ. at Urbana-Champaign. Dept. of Civil

Ininois Oniv. at Oroana-Champaign. Dept. of Civil Engineering.

R. S. Engelbrecht, and P. Amirhor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-252 973, Price codes: A06 in paper copy, A01 in microfiche. Report, 1975. 114 p, 29 fig, 23 tab, 41 ref.

Descriptors: *Leachate, Landfills, *Viruses, *Salmonella, *Streptococcus, Disinfection, Filtration, Reverse osmosis, Iron, Zinc, Municipal wastes.

The effect of sanitary landfill leachate on the survival of pathogens in landfills and leachate and the operational or environmental conditions influencing the inactivation of the bacteria and viruses were studied. Leachate samples were collected from a test lysimeter and from two landfill sites and the chemical and physical properties were characterized. The test pathogens, Salmonella typhimurium, a fecal streptococcus, poliovirus type 1, and echovirus type 7 were added to the different leachate samples and the inactivation capacity of each was evaluated. Leachate had a significant impact on the inactivation of the pathogens and the each was evaluated. Leachate had a significant impact on the inactivation of the pathogens and the inactivation capacity was influenced by the pH and temperature conditions. At pH 5.4, the inactivation capacity was greater than at pH 7.0 and continued to increase with increasing temperature. The inactivation capacity was affected by dilution of the leachate and the age of the landfill material. No correlation between the chemical and biological characteristics of the leachate was observed. Ultrafiltration techniques were used to fractionate the leachate to analyze the inactivation properties. The nitration techniques were used to fractionate the leachate to analyze the inactivation properties. The inactivation properties associated with the leachate were found to be in the 500 molecular weight permeate and in high concentrations of free metals such as iron and zinc or short chain fatty acids. Further fractionation of the leachate was performed with reverse osmosis. (Lisk-FRC) W79-08747

WASTE MANAGEMENT OPERATIONS, SAVANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA.

CAROLINA.
Department of Energy, Washington, DC.
Final Environmental Impact Statement Report
ERDA-1537, 1977, 693 p, 94 fig. 109 tab. 12 append.

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Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B-Sources Of Pollution

Descriptors: *Environmental effects, *Radioactive wastes disposal. *Leachate, *Nuclear wastes, *Public health, Liquid wastes, Solid wastes, Water pollution sources. Industrial wastes, Waste disposal, Environmental Impact Statement.

A detailed analysis is provided of the actual and potential environmental effects associated with waste management operations at the Savannah River Plant, a nuclear material production facility. The management of radioactive and non-radioac-tive gas, liquid, solid, and thermal wastes is considered. The effects of waste storage are explored. The effects of effluents from normal operations are discussed as well as the potential effects of abnormal operations of waste storage and handling facilities. Unavoidable effects are discussed, and alternative waste management practices are described. These alternatives include: No additional radioactive storage on-site; No additional waste storage and restoration of waste management areas; Con-tinuation of present waste management practices; and Continuation of existing operation with im-proved waste management practices consistent with ERDA policies and standards. A cost-benefit analysis of the alternatives is presented. (Small-FRC) W79-08780

5C. Effects Of Pollution

ENDOSULFAN POLLUTION OF RIVERS AND STREAMS IN THE LOSKOP DAM COTTON-GROWING AREA, Plant Protection Research Inst., Pretoria (South

C. P. Van Dyk, and C. G. Greeff. Agrochemophysica, Vol. 9, No. 3, p 71-76, 1977. 1 fig. 8 tab, 12 ref.

Descriptors: *Endosulfan, *Water pollution, *Pesticide residues, Loskop Dam, Rivers, Cotton, Aquatic animals, Fish, Invertebrates, Streams, Pol-lutants, Toxicity, Water pollution sources, Fertil-ity, Aquatic populations.

The occurrence of endosulfan in a heavily treated area was investigated to determine the effect of residues on the aquatic fauna. Residues in water and population counts of aquatic fauna were moni-tored in the Loskop Dam irrigation area. Acute toxicity tests, and growth, fertility, behavior, and toxicity tests, and growth, fertility, behavior, and short term high concentration pollution studies were conducted. Endosulfan was present in 4% of the samples collected; all endosulfan pollution occurred in the downstream part of the irrigation area. Rapid fluctuations in the aquatic fauna pollution were apparently mainly due to changes in the habitats and probably not due to endosulfan residues. Endosulfan was shown to be very toxic to fish. Growth of fish was not influenced by sublementations, due to accidental thal endosulfan concentrations; due to accidental introduction of predators to the fish fertility experiments, effects of endosulfan on fertility could not be determined. Invertebrate aquatic fauna were not affected by sublethal endosulfan concentrations. Low concentrations of endosulfan stimulated activity in Sarotherodon mossambicus; at higher concentrations stimulation decreased. (Schaefer-IPA) W79-08502

HEALTH HAZARDS OF SOUTH AFRICAN MINE WATER.

Gold Fields of South Africa Ltd., Johannesburg.

Journal of the South African Institute of Mining and Metallurgy, Vol. 77, No. 9, p 193-197, April 1977. 3 fig, 5 tab.

Descriptors: *Public health, *Potable water, *Mine water, Mine drainage, Water pollution sources, Water quality, Hazards, Diseases, Human diseases, Water quanty, razards, Diseases, ruman diseases, Sanitary engineering, Water pollution effects, Cholera, Dysentary, Typhoid, Environmental sanitation, Water purification, Epidemics.

The health hazards associated with potable water in South African mines is examined. Most mines have dual water supplies: potable water for human

consumption and fissure water for industrial use. The hazards of a single system for both types of water are considerable because of the even-present possibility of interconnection. Water-purification plants on the mine surface that are associated with possibility of interconnection. Water-purification plants on the mine surface that are associated with water-cooling towers may be the best way to provide cheap, safe industrial water. The principal enteric, bacterial, and para. 'tic diseases transmitted by mine water are cholera, typhoid, paratyphoid fever, bacillary and amoebic dysentary, and round-worms. As recently as 1973-74, epidemics of typhoid occurred in mines. Dysentary occurs excessively, and as long as it does, typhoid cases can be expected. A survey showed 2.94 per 1000 workers in African gold mines were chronic typhoid carriers. The only cholera epidemic in South Africa occurred in a mine in 1974; as in the case of typhoid and dysentary, water was the vehicle of transmission. Causes of the water pollution are discussed. Underground latrine areas are not properly maintained and often show contamination. A second source of contamination of mine water is body sweat. (Schaefer-IPA)

POWER PLANT ENTRAINMENT, A BIOLOGI-CAL ASSESSMENT. Academic Press, Inc., New York, New York, 1978. 271 p. Schubel, J. R., and Marcy, B. C., Jr.,

Descriptors: *Environmental effects, *Entrainment, *Powerplants, Thermal stress, Mortality, Aquatic life, Reviews, Workshop.

This book is the report of a workshop sponsored by The Ad Hoc Committee on Entrainment. The Workshop was held January 17-21 and March 20-22, 1977 at the Marine Sciences Research Center, Stony Brook, New York. The primary goals of the workshop were to assess the effects of stresses associated with entrainment (thermal, physical, and chemical); to develop guidelines for conceptual design and operation of power plants with once-through cooling systems to minimize the mortality of occasions received with antiquement received. of organisms associated with entrainment stresses and to outline research priorities. The book contains seven chapters written by different authors plus an appendix and a glossary. (See W79-08528 thru W79-08534) (Chilton-ORNL) 79-08527

INTRODUCTION.

In: Power Plant Entrainment, A Biological Assessment, Chapter 1. p 1-18, 1978. 3 fig, 3 tab, 12 ref.

Descriptors: *Reviews, *Environmental effects, *Entrainment, Powerplants.

This chapter was composed by the Ad Hoc Committee on Entrainment and sets forth an overview of the problems of entrainment. Included in the chapter are discussions of characteristics of steam electric plants, definition of entrainment, perceived effects of entrainment and adoption of thermal criteria and standards, explanation of the laws concerning entrainment, an assessment of the signifi-cance of entrainment losses and a summary of the goals of the workshop report. (See also 08527) (Chilton-ORNL)

THERMAL EFFECTS OF ENTRAINMENT, State Univ. of New York at Stony Brook. Marine Sciences Research Center.

J. R. Schubel, C. C. Coutant, and P. M. J. Woodhead.

In: Power Plant Entrainment, A Biological Assessment, Chapter 2, p 19-93, 1978. 13 fig, 9 tab, 97 ref.

Descriptors: *Environmental effects, *Entrainment, *Thermal stress, Powerplants, Mortality, Aquatic life.

This chapter presents a description of the range of time-excess temperature histories typical of operating and proposed steam electric stations; describes a conceptual framework for predicting thermal effects on organisms entrained by powerplants with once-through cooling systems; reviews the

literature on thermal tolerances of a variety of aquatic organisms; assesses the usefulness of field studies of entrainment in estimating thermally-induced mortalities; outlines the types of studies needed for an improvement in prediction and assessment of the thermal effects of entrainment; and specifies design and operating criteria for power plants with once-through cooling systems to minimize entrainment losses caused by thermal stress. (See also W79-08527) (Chilton-ORNL) W79-08529

BIOCIDES, Maryland Univ., Solomons. Chesapeake Biological

In: Power Plant Entrainment, A Biological Assessment, Chapter 3, p 95-134, 1978. 6 fig, 3 tab, 79 ref.

Descriptors: *Environmental effects, *Chlorination, Powerplants, Cooling water, Aquatic life,

This chapter presents an overview of the use of chlorine as a biocide in cooling water of power-plants. The effects of chlorination on various forms plants. The effects of chlorination on various forms of aquatic life (phytoplankton, invertebrates and fish) are discussed in some detail. It is noted that, while the chemistry of chlorine in uncontaminated freshwater is simple, in estuarine and marine systems it is complex due to the inherent chemical composition of these waters. Recommendations regarding chlorination processes in power plants include the use of intermittent, low level chlorination set the preferred technique. During periods of clude the use of intermitent, low level chlorina-tion as the preferred technique. During periods of limited growth of fouling organisms, cessation of chlorination and the use of mechanical scrubbing systems is recommended. For cooling tower sys-tems, it is recommended that blowdown products not be released into the receiving waters, but be placed into a receiving pond prior to release into the receiving waters. (See also W79-08527) (Chilton-ORNL)
W79-08530

EFFECTS AND IMPACTS OF PHYSICAL STRESS ON ENTRAINED ORGANISMS, NUS Corp., Pittsburgh, PA. Ecological Sciences

B. C. Marcy, Jr., A. D. Beck, and R. E.

In: Power Plant Entrainment, A Biological Assessment, Chapter 4, p 135-188, 1978. 4 fig, 2 tab, 98

Descriptors: *Environmental effects, *Entrainment, Powerplants, Aquatic life, Stress, Mortality, Physical stress.

Physical damage, principally occurring in passage through the pumps during entrainment, is identified as the major cause of mortality during the normal operational cycle of the power plant. Available data indicate that mortality is at least partially related to size and life stage of individual organisms, tolerance of the individual species and life stage, and difference invocations and the contractions. organisms, tolerance of the individual species and life stage, and differences in power plant cooling system designs and operational characteristics. It is suggested that the impact of power plants can be minimized by siting in nonproductive areas and by utilizing closed cooling systems. (See also W79-08527) (Chilton-ORNL) W79-08531

CUMULATIVE EFFECTS, A FIELD ASSESS-MENT.

MEN1, A. D. Beck. In: Power Plant Entrainment, A Biological Assess-ment, Chapter 5, p 189-210, 1978. 1 tab, 16 ref.

Descriptors: *Environmental effects, *Entrainment, Powerplants, Aquatic life. Thermal stress. Chlorination, Mortality, Physical stress.

Results of field studies at 14 power plants with once-through cooling systems are summarized in tabular form. In those cases where mortality of entrained ichthyoplankton and juvenile fishes has been apportioned among the several kinds of stresses (thermal, chemical, and physical), physical stresses i tality of larval as (Chilton-W79-085

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Effects Of Pollution-Group 5C

stresses usually dominate. Data indicated that the relative importance of chlorination in causing mortality of zooplankton may be greater than for larval and juvenile fishes. (See also W79-08527) W79-08532

ON SELECTING THE EXCESS TEMPERA-TURE TO MINIMIZE THE ENTRAINMENT

MORTALITY RATE.
In: Power Plant Entrainment, A Biological Assessment, Chapter 6, p 211-227, 1978. 10 fig, 1 tab.

Descriptors: *Environmental effects, *Entrainment, Aquatic life, Mortality, Temperature, Thermal stress, Stress, Chemical stress, Physical stress.

This chapter deals with the fundamental concept that the optimum excess temperature at which to operate a power plant cooling system must include consideration of thermal, chemical and physical stresses rather than thermal stresses alone. Emphasis is splaced on the rule that operation of a power plant cooling system at a small excess temperature can be more harmful than operation at a larger excess temperature. (See also W79-08527) (Chilton-ORNL) W79-08533

CONCLUSIONS AND RECOMMENDATIONS. In: Power Plant Entrainment, A Biological Assessment, Chapter 7, p 229-242, 1978. 3 ref.

Descriptors: *Environmental effects, *Entrainment, Powerplants, Aquatic life, Research and development.

In this chapter by the Ad Hoc Committee on Entrainment it was concluded that the minimizing of entrainment mortality can be accomplished by careful site selection as well as plant design and operating criteria. The use of closed-cycle cooling systems is recommended. Research priorities which are recommended include the development of thermal resistance curves for a variety of organic of thermal resistance curves for a variety of organ-isms, study of time-excess temperature histories, laboratory verification of predicted mortalities, studies on sublethal effects of acute thermal shock, research into the chemistry of chlorine and ozone in natural waters, tolerance studies, studies on behavioral responses of a variety of organisms, studies on accumulation and biomagnification of chlorination products and effects of physical stresses. (See also W79-08527) (Chilton-ORNL) W79-08534

METABOLIC RESPONSE TO THERMAL CHANGES OF THE ADULT FIDDLER CRAB, UCA PUGILATOR, AND THE EFFECT OF

PCB'S, South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research. F. J. Vernberg, M. S. Guram, and A. M. Savory. Marine Biology, Vol. 48, No. 2, p 135-141, 1978. 8

Descriptors: *Environmental effects, *Temperature, Thermal stress, Crabs, Metabolism, Respiration, Polychlorinated biphenyls.

Aroclors 1016 and 1254 did not appear to influence the respiratory response pattern of cold- or warm-acclimated crabs over the thermal range of 10 to 30C. Metabolic measurements made at one acclimation temperature showed that these Aroclors mation temperature showed that these Aroclors did effect respiration rates in a unpredictable manner: at 15C no consistent effect was seen for males but the metabolic rate was reduced in females; at 25C the rates were increased for males but the metabolic rate was reduced in females; at 25C the rates were increased in both sexes; and at 35C a tendency towards metabolic inhibition was observed in both sexes. (Chilton-ORNL) W79-08535

AGONISTIC BEHAVIOR IN CRAYFISH IN RE-LATION TO TEMPERATURE AND REPRO-DUCTIVE PERIOD, Savannah River Ecology Lab., Aiken, SC.

J. H. Thorp. Oecologia, Vol. 36, No. 3, p 273-280, 1978. 1 fig, 2 tab, 22 ref.

Descriptors: *Environmental effects, *Temperature, Behavior, Seasonal, Reproduction.

Cambarus latimanus LeConte were acclimated for 2 wks at 9.5, 14, 22, and 30C in summer and at 9.5 and 22C in winter. Agonistic behavior of pairs of the same sex was recorded for 1 h following acclimation. Three experimental steps (acclimation, testing, and temperature-readjustment) were carried out with all crayfish pairs. Duration of total acquisite, behavior, reaximum duration of a single ried out with all crayfish pairs. Duration of total agonistic behavior, maximum duration of a single agonistic interaction, and average length of an agonistic encounter were all found to be inversely related to acclimation temperature. It was concluded that for ectothermic species whose agonistic behavior is closely associated with reproductive processes (including competition for mates) the level of agonism will vary, either directly or inversely, depending upon whether the reproductive period is cued by increasing or decreasing seasonal temperatures, respectively. (Chilton-ORNL) W79-08536

STRUCTURE-TOXICITY CORRELATIONS OF ORGANIC CONTAMINANTS IN AQUEOUS COAL-CONVERSION EFFLUENTS, Oak Ridge National Lab., TN; and Tennessee Univ., Oak Ridge. School of Biomedical Sciences. T. W. Schultz, L. M. Kyte, and J. N. Dumont. Archives of Environmental Contamination and Toxicology, Vol. 7, No. 4, p 457-463, 1978. 2 fig, 1 tab, 13 ref.

Descriptors: *Environmental effects, *Toxicity, Organic compounds, Protozoa, Effluents, Coals, Aquatic life, Coal-conversion effluents, Organic structure, Tetrahymena pyriformis.

This investigation examines possible correlations between the partition coefficients in octanol-water systems of a group of potential pollutants and the toxicity of these compounds to Tetrahymena pyriformis. It was found that, generally, an increase in a likely artitioning increase to a continuous and the contract of alkyl substitution increases toxicity and decreases solubility. Compounds containing the equivalent of two or more methyl groups were found to be more toxic than those with one or no alkyl substitutions. (Chilton-ORNL) W79-08537

FACTORS REGULATING THE REPRODUCTIVE CYCLES OF TWO NORTHEAST PACIFIC CHITONS, TONICELLA LINEATA AND T.

British Columbia Univ., Vancouver. Dept. of Zoo-

logy.
J. H. Himmelman.
Marine Biology, Vol. 50, p 215-225, 1979. 7 fig, 1

Descriptors: *Environmental effects, *Tempera-ture, *Phytoplankton, Spawning, Reproduction, Seasonal, Chitons, Tonicella lineata, Tonicella in-

Results of this study show that the same reproductive pattern is exhibited by the two closely related chitons Tonicella lineata and T. insignis. There is a prolonged period of gonadal growth extending through the coldest part of the year, and an abrupt spawning at the time of the spring phytoplankton outburst. Various phases of annual temperature and photoperiod cycles appear to coincide with particular phases of gametogenesis and could act as external cues. While phytoplankton appears to be the major stimulus for spawning, there is some evidence that temperature may influence spawning. Temperature may influence spawning if conditions are unseasonably cold. (Chilton-ORNL) W79-08538

GROWTH PATTERNS OF CODIUM FRAGILE SSP. TOMENTOSOIDES IN RESPONSE TO TEMPERATURE, IRRADIANCE, SALINITY, AND NITROGEN SOURCE,

Rhode Island Univ., Kingston. Dept. of Botany. M. D. Hanisak. Marine Biology, Vol. 50, No. 4, p 319-332, 1979. 12 fig. 8 tab, 40 ref.

Descriptors: *Environmental effects, *Algae, Growth rates, Reproduction, Temperature, Light, Salinity, Nitrogen, Seasonal, Codium fragile spp tomentosoides.

In this study on growth patterns, reproduction and productivity of Codium fragile it was found that maximal growth was more significantly correlated with temperature than with any other factor measured. Multiple correlation models suggested an interaction between temperature, irradiance and available nitrogen. Although growth and repro-duction are confined to warmer months, this spe-cies of algae can survive severe winter conditions and mitiate new growth in the spring. (Chilton-ORNL) W79-08539

COMPARATIVE STUDIES ON THE METABO-LISM OF SHALLOW-WATER AND DEEP-SEA MARINE FISHES, V. EFFECTS OF TEMPERA-TURE AND HYDROSTATIC PRESSURE ON OXYGEN CONSUMPTION IN THE MESOPE-LAGIC ZOARCID MELANOSTIGMA PAMME-

LAS, California Univ., Los Angeles. Dept. of Biology. B. W. Belman, and M. S. Gordon. Marine Biology, Vol. 50, No. 3, p 275-281, 1979. 2 fig, 4 tab, 25 ref.

Descriptors: *Environmental effects, *Metabolism, Fish, Temperature, Hydrostatic pressure, Shallow water, Deep water, California, Melanostigma pam-

Measurements of routine oxygen consumption rates in Melanostigma pammelas were made over ecologically relavent ranges of 3 variables: temperature, 3 to 10 C; hydrostatic pressure, 1 to 170 atm; and oxygen partial pressure, 1 to 160 mm Hg. The most significant finding of the study was that within the ranges of temperatures, hydrostatic pressures and dissolved oxygen levels normally encountered by these fish in the basins off southern California, only temperature has a significant effect California, only temperature has a significant effect on routine rates of weight specific oxygen consumption. QIO's were 6.75 between 3 and 5 C, 1.47 between 5 and 7 C, and 17.4 between 7 and 10 C. (Chilton-ORNL) W79-08540

ESTUARINE PROCESSES, VOLUME I AND II. For primary bibliographic entry see Field 2L. W79-08543

RIVER POLLUTION AND PEOPLE,

Water Research Center, London (England). Pollution B (Rivers) Div. J. H. Garland.

Water, No. 25, p 46-48, March 1979. Presented at the conference 'Water Quality: The Implications of the Control of Pollution Act 1974; Part II.' 1 fig, 3

Descriptors: *Rivers, *Water pollution, *Water quality control, England, Wales, Water pollution control, Public health, Water quality, Urbanization, Water pollution effects, Water policy, Water quality standards, Effluents, Human population.

The relationship between river pollution and people is examined. The uses of rivers, in an ideal world, should be balanced such that the essential drainage function (a polluting process) does not oust the quality-sensitive in situ and abstractive uses. Effluent standards are needed to protect the water consumer from dangers of consumption of bacterially contaminated water, ingestion of substances tolerated by river biota but harmful to humans, and chronic ingestion of substances tethal to man in small quantities, water treatment, sewage treatment, and rejection of sources not complying with standards afford protection against these dangers. A circular contribution of sources are designed as a substance of the source of t gers. A simple equation relating population density and effluent consent standards to river water qual-

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Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C-Effects Of Pollution

ity is detailed. The relationship between concentra-tions of biochemical oxygen demand (BOD) and inorganic nitrogen in rivers and catchment popula-tion densities at three standards for effluent treattion densities at three standards for effluent treat-ment is graphed. The small proportion of polluted rivers in England and Wales probably occur be-cause the population densities of their catchments are large, and their lack of treatment facilities, which is tolerated in less populous regions has a very detrimental effect on river water quality. Class III rivers should be redefined as those rivers canable of supporting coarse figh, but which are capable of supporting coarse fish, but which are not required for public water supply. Urban rivers should not be reclaimed past the point where they would support coarse fish. (Schaefer-IPA) W79-08590

WATER QUALITY GUIDELINES FOR ACID MINE DRAINAGE AND STRIP MINE AREAS IN IOWA.

Energy and Mineral Resources Research Inst., Ames, IA. Dept. of Animal Ecology. For primary bibliographic entry see Field 5B. W79-08611

POTENTIAL POLLUTION OF A MARINE EN VIRONMENT BY LEAD ALKYLS: THI CAVTAT INCIDENT, Istituto di Ricerca sulle Acque, Bari (Italy). G. Tiravanti, and G. Boari.

Environmental Science and Technology, Vol. 13, No. 7, p 849-854, July 1979. 2 fig, 2 tab, 43 ref.

Descriptors: *Lead, *Pollutants, *Water pollution Descriptors: 'Lead, 'Pollutants, 'Waster pollution effects, Water pollution, Oceans, Sea water, Chemicals, Effects, Marine biology, Fish, Algae, Bacteria, Crustaceans, Sampling, Chemical analysis, Ships, 'Yugoslavia, 'Cavtat, 'Adriatic Sea, Lead compounds, Tetramethyllead, Tetraethyllead

The 2,000-ton Yugoslav cargo ship Cavtat, containing about 325 tons of lead alkyl antiknock compounds, sank on July 14, 1974, in 94 m of water, 3.5 miles southeast of the Ontario Cape, in the Adriatic Sea. The organic nature of this load the Adriatic Sea. The organic nature of this load gave rise to pollution problems that had not yet been considered in the literature. A significant release of lead alkyls was prevented by salvaging the material, with a loss of only 7%. A preliminary evaluation of the potential polluting effects of lead alkyl dispersion in the marine environment was reported, solid evaluation being based on a diffusion/convection transport model which allows the compound hypothetical concentration distribution in the wreck area to be calculated. Analysis of in the wreck area to be calculated. Analysis of seawater, sediments, and biological samples near the wreck, using standard analytical methods, verified that there was little environmental effect. (Sims-ISWS) W79-08627

ENVIRONMENTAL EFFECTS OF WESTERN COAL COMBUSTION PART II - THE AQUATIC MACROINVERTEBRATES OF ROSEBUD

CREEK, MONTANA,
Montana State Univ., Bozeman. Dept. of Biology.
For primary bibliographic entry see Field 5A.

THE ACUTE TOXICITY OF ZINC TO RAINBOW AND BROOK TROUT, COMPARISONS IN HARD AND SOFT WATER, Environmental Research Lab., Duluth, MN. G. W. Holcombe, and R. W. Andrew.

Available from the National Technical Information

Available from the National Technical Information Service, Springfield, VA 22161 as PB-289 939, Price codes: A03 in paper copy, A01 in microfiche. U.S. Environmental Protection Agency, Report EPA 600/3-78-094, 17 p, 1978. 4 tab, 32 ref.

Descriptors: *Zinc, Metals, *Toxicity, Bioassay, *Brook trout, *Rainbow trout, Laboratory tests, Freshwater fish, Hydrogen ion concentration, Alkalinity, *Hardness(Water), Soft water, Hard water, Water quality, Methodology, Zinc toxicity, Water shifting officers. Water pollution effects.

The means and ranges of the 96-hour LC50's derived from three tests were 0.55 (0.37 to 0.76) and 2.5 (1.9 to 3.0) mg Zn/liter for rainbow and 2.0 (1.6 to 2.4) and 6.0 (5.0 to 7.0) mg Zn/liter for brook trout in soft and hard water, respectively. Based on overall means, brook trout were approximately 2.7 times more resistant than rainbow trout. Zinc toxicity to both species increased with increasing pH, and decreased with increasing hardness and alkalinity. (Katz-EIS) W79-08659

CHANGES IN PLANKTON AND BENTHOS OF THE SEA OF AZOV UNDER THE INFLUENCE OF ANTHROPOGENIC FACTORS, Azovskii Nauchno-Issledovatelskii Inst. Rybnogo Khozyaistva, Rostovna-Donu (USSR).

For primary bibliographic entry see Field 5A. W79-08660

A NEW UNITED STATES BIOMONITORING SYSTEM FOR THE AQUATIC ENVIRONMENT,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiolo-For primary bibliographic entry see Field 5A. W79-08661

PHYTOPLANKTON IN THE NOVO-BAVARS-KOYE RESERVOIR AS AN INDICATOR OF TYPE AND THE BIOLOGICAL-SANITARY CONDITION OF A LAKE, Kharkov State Univ. (USSR).

For primary bibliographic entry see Field 5A. W79-08662

EFFECT OF PESTICIDES AND NARCOTANTS ON BIVALVE MOLLUSCS, Marathwada Univ., Aurangabad (India). Dept. of

Zoology. U. H. Mane, M. S. Kachole, and S. S. Pawar. Malacologia, Vol. 18, p 347-360, 1979. 4 fig, 5 tab,

Descriptors: *Toxicity, Bioassay, Laboratory tests, Molluscs, *Commercial shellfish, Water pollution effects, Marine fisheries, Marine animals, *India, *Pesticides, *Narcotants, DDT, Chlorinated hydrocarbon pesticides, Malathion, Phosphioate, Pesticides, Phenobarbital, Hexobarbital, Path of pollutants, Katyelsia, Donax, Water pollution sources.

The reactions of the marine bivalves Katelysia opima and Donax cuneatus (both commercially important species in India), to various pesticides and narcotants were studied under laboratory conditions. Reactions varied, but thiometon and malathion were found to have the least effect on K. opima and D. cuneatus, respectively, while malathion and DDT were found to be more toxic to K. opima and D. cuneatus, respectively. D. cuneatus was little affected by the narcotics phenobarbital sodium and hexobarbital sodium, but K. opima was affected by phenobarbital sodium. The commer-cially important freshwater bivalve Indinaia caeruleus was studied in detail as regards the influence of polluting substances on the neurosecretory cells, the digestive gland and the intestine. All organs were affected in different ways. (Katz-EIS) W79-08663

DETERMINATION OF PENTACHLORO-PHENOL IN MARINE BIOTA AND SEA WATER BY GAS-LIQUID CHROMATO-GRAPHY AND HIGH-PRESSURE LIQUID CHROMATOGRAPHY, Environmental Research Services, Gulf Breeze,

For primary bibliographic entry see Field 5A. W79-08664

THE EFFECTS OF HALOGEN TOXICANTS ON SURVIVAL, FEEDING AND EGG PRODUCTION OF THE ROTIFER BRACHIONUS PLI-CATILIS.

Woods Hole Oceanographic Inst., MA.

J. M. Capuzzo. Estuarine and Coastal Marine Science, Vol. 8, p 307-316, 1979. 2 fig. 7 tab, 24 ref.

Descriptors: Water pollution effects, *Zooplank-ton, Toxicity, Mortality, Bioassay, *Chlorine, Chlorination, Halogen, Rotifers, Plankton entrain-ment, Animal physicology, Reproduction, Water temperature, Residual chlorine, Brachionus, emperature, Chloramine

The toxicity of free chlorine and combined chlorine as chloramine to the rotifer Brachionus plicatiis at three exposure temperatures has been evaluated. Chloramine was more toxic to rotifers than the ce. The exposure temperatures has been evaluation.

cd. Chloramine was more toxic to rotifers than the free halogen form with LC50 values for 30-min exposures at 20 C of 0.35 mg/l applied chloramine and 1.20 mg/l applied free chlorine, 0.02 mg/l and 0.18 mg/l residual levels, respectively. The synergistic effect of temperature on the toxicity of both halogen forms was also noted. Rotifers surviving exposure to either halogen toxicant had significantly lower filtration rates and egg production rates than control animals. The reduced reproductive rates were not sustained by the second generation of rotifers and it appears that exposure to free chlorine or chloramine does not result in a permanent alteration in the reproductive potential of rotifer populations. (Katz-EIS)

THE WEST FALMOUTH OIL SPILL: HYDRO-CARBONS IN THE SALT MARSH ECOSYS-

Victoria Ministry for Conservation, Melbourne Australia). For primary bibliographic entry see Field 5A. W79-08666

THE ECOLOGY AND REPRODUCTIVE EFFI-CIENCY OF THE SIBERIAN STURGEON, ACT-PENSER BAERI, IN THE OB AS AFFECTED BY HYDRAULIC ENGINEERING WORKS, Siberian Research Inst. of Pisciculture, Tymen

(USSR).
N. P. Votinov, and V. P. Kas'yanov.
Journal of Ichthyology, Vol. 18, No. 1, 1978. p 2029. 3 fig. 10 tab, 14 ref. (Translation from Russian).

Descriptors: Freshwater fish, *Sturgeon, *Dams, Damsites, *Reproduction, Commercial fisheries, *Upper Ob River, Spawning, *Stream flows, Peakflows, Hydrology, Hydraulic structures, Hydraulic engineering, Juvenile fish, Sturgeon larvae.

Results of observations carried out on the repro-Results of observations carried out on the reproduction of the Siberian sturgeon, Acipenser baeri, in the upper Ob River and on the downstream migration of its young during the period 1968-1974 are presented. The direct relationship between water levels in the region of the spawning grounds during the spawning period and year-class strength for the respective years is established. The reduction in recruitment as a result of dams, is mainly due to a shift in the times of peak flows and a reduction in the peak flows. (Katz-EIS) W79-08667

CHANGES IN THE PHYTOPLANKTON OF AN ENGLISH LAKE, 1945-1977, Freshwater Biological Association Ambleside

For primary bibliographic entry see Field 5B. W79-08668 (England).

AIR-POWERED STREAM TANK FOR LABO-

RATORY USE,
Toronto Univ., (Ontario). Div. of Life Sciences.
For primary bibliographic entry see Field 5B.

LEAD ACCUMULATION IN AQUATIC PLANTS FROM METALLIC SOURCES IN-AQUATIC CLUDING SHOT,

Montana Univ., MO. Dept. of Botany. For primary bibliographic entry see Field 5A. W79-08670

PECULIAR ACCUMULATION OF COBALT-60 BY THE BRANCHIAL HEART OF OCTOPUS, National Inst. of Radiological Sciences, Nakami

ato (Japa Station. For prima W79-0867

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Effects Of Pollution-Group 5C

ato (Japan). Marine Radio-Ecological Research Station. For primary bibliographic entry see Field 5A. W79-08671

EXPOSURE OF FINGERLING SPRING CHINOOK SALMON TO MIXTURES OF FURANACE-10, QUINALDINE, AND MS-222, National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.

The Progressive Fish Culturist, Vol. 41, No. 2, p 85-86, 1979. 2 ref.

Descriptors: *Mortality, *Antibiotics(Pesticides), *Chinook Salmon, *Anesthetic agents, *Furanace-10, Aquiculture, Bactericides, Fungicides, Fishphysiology, Fish handling facilities, Fry, Fish hatcheries, Chemical properties, Chemical analysis, Fish behavior

This study examines the efficacy of the broad-spectrum anti-microbial agent Furanace-10 in pre-venting the high pathogen-related mortality fre-quently associated with the crowded conditions of fish hatcheries and research operations. In order to test for possible synergistic effects fingerling chi-nook salmon were exposed to three different mix-tures of Furanace-10 and anesthetic agents (Furan-ace-10 and MS-222, Furanace-10 and quinaldine, Furanace-10 and a mixture of the two anesthetics). None of the three mixtures tested conspicuously altered behavior or caused significant immediate mortality. It therefore apppears that solutions of three chemicals could be used safely as baths or dips for experimental purposes. (Deal-EIS)

TOXICITY OF SWASCOL (TRADE NAME) 1P (SLS) TO CHANNA PUNCTATUS AND CIRRHINA MRIGALA: BIOCHEMICAL ALTERATIONS, D. A. V. Coll., Muzaffarnagar (India). Pollution Relevant Research Lab. For primary bibliographic entry see Field 5A. W79-08677

EFFECT OF THERMAL EFFLUENTS AND RE-TENTION TIME ON LAKE FUNCTIONING AND ECOLOGICAL EFFICIENCIES IN PLANKTON COMMUNITIES, Polish Academy of Sciences, Warsaw. Inst. of

Ecology.

For primary bibliographic entry see Field 5A. W79-08678

SUCCESSION OF AQUATIC INSECTS CAUSED BY MILD ORGANIC POLLUTION IN RIVERS (IN JAPANESE), Freshwater Fisheries Lab., Tokyo (Japan).

Bulletin of the Freshwater Fisheries Research Laboratory, Vol. 28, No. 2, p 141-153, 1978. 1 fig, 6 tab, 16 ref. (English Summary).

Descriptors: Benthos, *Aquatic insects, On-site-investigations, Japan, *Water pollution effects, *Stoneflies, *Mayllies, Animal grouping, Animal populations, Sampling, Organic wastes, *Organic pollution, Freshwater benthos.

Studies of aquatic insect populations were conducted between 1958 and 1976 in rivers which were not polluted, mild pollution and moderate pollution. An attempt was made to correlate aquatic insect population with the degree of pollution. Insects of the authors group I, which were mostly stoneflies, dominated in unpolluted streams. Insects of group II, which included mayflies, dominated in the mildly polluted streams, while insects of both groups were observed in very mildly polluted streams. The distribution of both groups were not affected by the altitude. (Katz-EIS)

EFFECT OF OXYGEN SUPPLY IN CONCRETE PONDS ON ENVIRONMENTAL FACTORS AND PRODUCTION OF FISH BY FEEDING (IN JAPANESE),

Freshwater Fisheries Research Lab., Tokyo (Japan).
For primary bibliographic entry see Field 5A.
W79-08680

PESTICIDE AND PCB OF COMMON EIDER, HERRING GULL AND GREAT BLACK-BACKED GULL EGGS, Fish and Wildlife Service, Laurel, MD. Patuxent Wildlife Research Center. For primary bibliographic entry see Field 5B. W79-08683

ICHTHYOTOXICOLOGICAL EVALUATION OF THE ELECTROCONDUCTIVE RESIN, (IN BOHEMIAN), Vyzkumny Ustav Rybarsky a Hydrobiologicky, Vodnany (Czechoslovakia).
M. Bohm, Z. Svobodova, and J. Tauc. Buletin VURH Vodnany, Vol. 15, No. 1, p 33-37, 1979, 2 fig. (English summary).

Descriptors: *Toxicity, *Chemical wastes, *Fish physiology, *Electrophoresis, *Poecilia, Guppies, Bioassay, Carp, Rainbow trout, Mortality, Hazards, Poisons, Chemical analysis, Chemical properties, Resins, Electroconductive resin, ECR paper, Kaolin.

The electroconductive resin ECR 77 is intended for use in the one step production of electrophoreographic paper. From the ichthyotoxicological view-point, this substance is highly toxic for fish. The LC30 for the carp within 48 hours is 27.2 mg/l, for the rainbow trout 4.2 mg/l, and for Poecilia reticulata 3.7 mg/l. Caolin was added to this resin in a 1.4 ratio to inactivate the poison. The toxicity of the ECR-77 paper for fish, as influenced by the coagulating action of caolin, is about 3-7 times lower than that of untreated ECR-77 paper. Despite this, the resin of ECR-77 remains a potential hazard to the quality of Czechoslovak waters. (Deal-EIS) W79-08664 W79-08684

THE ROLE OF ENVIRONMENTAL ASSESSMENT IN A MAJOR PULPMILL EXPANSION PROGRAM,

Kimberley-Clark of Canada, Ltd., Terrace Bay

C. F. Gorham. In: Proceedings of the 24th Ontario Industrial Waste Conference, held May 30-June 1, 1977, Toronto, Canada. p 24-45, 1977. 1 fig.

Descriptors: *Pulp and paper industry, *Industrial wastes, *Water pollution sources, *Lumbering, *Waste water treatment, Treatment facilities, Dissolved oxygen, Environmental effects.

The environmental impact of a pulpmill expansion program was investigated by Kimberly-Clark of Canada Limited. The production facilities at the Terrace Bay mill were expanded from 425 tons/day to 1250 tons/day. Although the mill effluent will triple in quantity, the net effect on the Moberly Bay is expected to decrease because of increased in polaric controls and the politicing action of the ly Bay is expected to decrease because of increased in-plant controls and the polishing action of the present lagoon system. The impact of increased logging activity on the Long Lake - Aguasabon River system may cause a number of problems including the smothering of benthic invertebrate and fish spawning beds with bark, and the reduction of dissolved oxygen levels through decomposition of bark and logs. Increased logging could cause increased potential for forest fires and impact on wildlife. The effects of growth in the town's population are explored. (See also W79-08701) (Small-FRC) W79-08702

SILVICULTURAL CHEMICALS AND PROTECTION OF WATER QUALITY.
Oregon State Univ., Corvallis. School of Forestry.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-271 923.
Price codes: All in paper copy, A01 in microfiche.
Report EPA-910/9-77-036, 1977. 232 p, 10 fig. 6 tab, 124 ref, 4 append.

Descriptors: *Forest management, *Pesticides, *Herbicides, *Water pollution sources, *Toxicity, Water quality, Soil management, Erosion control, Organic pesticides.

A comprehensive review of silvicultural chemicals management practices is presented, and chemicals are evaluated in relation to both water quality and silviculture objectives. Various procedures are outlined that permit reaching management goals without adverse impacts on water quality. Pollution control guidelines are presented, and criteria are proposed for limiting concentrations of chemicals in water. The toxicological properties of the major forestry chemicals are reviewed including specificata on a wide variety of organisms. Serious water quality impacts are avoided by limiting the use of organochlorine insecticides and by avoiding the direct application of insecticides to open water. A comprehensive review of silvicultural chemicals organochlorine insecticides and by avoiding the direct application of insecticides to open water. Adequate buffer strips and special application techniques near water are recommended. The use of herbicides which control vegetation but do not cause siltation or other soil damage is recommended. Also, priority should be given to the training and licensing of applicators. (Small-FRC) W79-08769

WASTE MANAGEMENT OPERATIONS, SA-VANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA.

Department of Energy, Washington, DC. For primary bibliographic entry see Field 5B. W79-08780

MARKET STRUCTURE AND EXTERNALITIES: THE CASE OF WATER POLLUTION IN ENGLAND AND WALES,
D. J. Storey.
The Journal of Industrial Economics, Vol. 27, No. 2, December 1978, p 149-161. 1 fig, 2 tab, 22 ref, 2

Descriptors: *Economics, *Market structure, *England, *Wales, *Externalities, *Water pollution control, Costs, Industrial wastes, Effluents, Pollution abatement, Rivers, Regression analysis, Regulation, Profit maximization, Waste disposal, Waste treatment, Behavior, Law enforcement, Competition, Motivation, Policy, Governments.

tion, Motivation, Policy, Governments.

This paper analyzes effects of relaxing two significant assumptions of externality theorists in regard to pollution control: (1) that both dischargers and enforcement bodies play purely passive roles; and (2) that all polluters are profit maximizers (cominimizers) operating in a perfectly competitive selling market. Within profit-maximizing polluters can use resources in opposing the authority; firms in noncompetitive industries will have an advantage in such conflicts over small competitive companies. Replacement of the profit-maximizing hypothesis with one in which managers act like private citizens, and make descretionary expenditures results in opposite predictions. These hypotheses were tested with the case of water pollution control in England and Wales. Regression analysis showed a U-shaped relationship between pollution control expenditures and at least one index of market imperfections, leading to several conclusions; (1) neither market structure nor the role of the enforcing authority can be omitted from externality analysis, (2) water quality improvement may not have been achieved in a cost-effective way since under a system of regulation the middle concentration firms will always have an incentive to challenge the authority rather than install equipment, (3) water pollution generated by imperfectly competitive firms may not be a true externality. ment, (3) water pollution generated by imperfectly competitive firms may not be a true externality, and (4) antitrust policies may increase social damage from pollution through inhibiting discretionary spending on abatement. (Lynch-Wisconsin) W79-08808

SEASONAL AND DEPTH DISTRIBUTION OF LIMNOCALANUS MACRURUS AT A SITE ON WESTERN LAKE SUPERIOR, Washington State Univ., Pullman. Dept. of Bacte-

riology and Public Health.
J. B. Conway.
Journal of Great Lakes Research, Vol. 3, No. 1-2.

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Group 5C-Effects Of Pollution

p 15-19, 1977. 3 fig. 2 tab, 3 ref.

Descriptors: *Lake Superior, *Limnocalanus macrurus, *Copepods, *Life history studies, *Depth, *Seasonal, Growth stages, Copepodids, Calanoidea, Zooplankton, Great Lakes, Lakes, Distribution, Biomass, Ecology, Baseline studies, Morphology, Minnesota, On-site investigations.

The relict calanoid copepod Limnocalanus ma-crurus was studied 1970-71 in western Lake Superior, 0.8 km offshore from Larsmont, Minnesota. Copepodid stages I-IV are most numerous prior to July, stage V in July, and stage VI August-September. L. macrurus's contribution to total crustacean zooplankton biomass increases with depth, and is frequently dominant at 40-50 m. Midday sample when light is maximal show that most copepodids of a specific stage prefer a particular depth which increases with maturity of the stage. At five meters, where crustacean zooplankton biomass reaches maximum volume in August-September, L. macrurus contributes little, but plays an increasing-ly greater role with depth. Total zooplankton biomass decreases with depth. Samples were collected at depths of 5, 10, 20, 30, 40, and 50 m with Clarke-Bumpus plankton samplers. Stage VI copepodids are numerous at every depth except five numbers generally increase with depth due to female increase; male stage VI copepdid numbers remain relatively constant. The male-to-female ratio of stage V is 1:1.1, and of VI, 1:2.7. The length-weight regression for L. macrurus, used to measure its contribution to total zooplankton biomass, is: Log sub 10 dry wt (mu-g) = 0.98 length (mm) - 0.79. (Lynch-Wisconsin) W79-08812

PROPERTIES OF AN AQUATIC MICRO-ECO-SYSTEM: I. GENERAL INTRODUCTION TO THE PROTOTYPES,

Amsterdam Univ., (Netherlands). Limnology Lab. J. Ringelberg, and K. Kersting. Archiv fur Hydrobiologie, Vol. 83, No. 1, p 47-68, May 1978. 6 fig, 1 tab, 36 ref.

Descriptors: *Ecosystems, *Experimental ecosystems, *Analytical techniques, *Algae, *Zooplankton, *Bacteria, *Research equipment, Population dynamics, Daphnia magna, Cladocera, Chlorella Scenedesmus quadricauda, Trophic level, vulgaris. Degradation(Decomposition), Methodology, Phytoplankton, Herbivores, Grazing, Phosphates, Nutrients, Phosphorus, Buffering, Reviews, Photosynthesis, Mineralization, Cycling nutrients, Biological communities, Chlorophyta.

Two prototype experimental ecosystems, smalland large-scale, each consisting of three interconnected aquaria containing separate populations of autotrophs, herbivores, and decomposers. In test of the large prototype, volumes of the three aquaria were 100 1, 7.5 1, and 56 1; flow rates of 0.3 and 18 Were 100 1, 7.5 1, and 36 1; flow rates of 0.3 and 0.9 1/hr were tested, with dilution times for the three units of 13.7 and 4.7 days, 1.0 and 0.36 days, and 7.7 and 2.6 days. The small prototype had volumes of six, 1.8, and 1.8 1 flow rate of 0.03 1/hr, and dilution times in the three units of 8.6, 2.6, and 2.6 days. In the large system the algal subsystem was inoculated with pure cultures of Chlorella vulgaris and Scenedesmus quadricauda, but other algae soon entered the system. The small proto-type's algal unit was filled with C. vulgaris. Both systems' herbivores consisted mainly of Daphnia magna. Most microsystems described in the literature lack a sufficiently long lifetime in a stable or predictable state, thought to be due to excessivly easy accessibility of consumers to producers. The prototypes largely overcome this problem; set up in 1973, they remain in good condition. High mineralization and steady-state algal biomass are maintained. Though a dense daphnid population may be present, it fluctuates greatly. The decomposer unit of the large prototype developed a high buffering capacity; inorganic phosphate output was constant, for example, regardless of a variable input of organic phosphorus. In the small prototype biomass cycles of algae and daphnids were observed. (Lynch-Wisconsin) W79-08816

NITRATE EXCRETION BY A BLUE-GREEN ALGA, OSCILLATORIA REBESCENS D.C.,

Tokyo Univ. (Japan). Ocean Research Inst. M. Ohmori. Archiv fur Hydrobiologie, Vol. 83, No. 4, p 485-493, September 1978. 5 fig. 1 tab, 21 ref.

*Oscillatoria rubescens, Nitrates, *Lake Schoh(West Germany), *Excretion, Assimilation, Cyanophyta, Algae, Phyto-plankton, Plant growth, Growth rates, Metalim-nion, Lakes, West Germany, Light intensity, Pho-

Nitrite excretion by the cyanophyta Oscillatoria rubescens in laboratory tests and in Lake Schoh, West Germany, correlated inversely with light intensity, and was affected by algal growth rate and phase and nitrate concentration. Metalimnetic nitrite maxima may be due in part to O. rubescens, which often occurs there. Growth of the algal cells with nitrate concentrations of 140 mg N/l at 20 C at light intensities ranging from 400-3500 lux led to accumulation of nitrite in the culture medium at up to seven mg N/l. Ammonia was assimilated more rapidly, but no nitrite accumulation resulted. Nitrite was produced by O. rubescens when incubated in Lake Schoh at depths of 3.8, 7.5, and 10.0 m July 1975; the highest nitrite concentration (0.58) in July 1975; the highest nitrite concentration (0.58 mg N/I) was observed at 7.5 m. Results show that Oscillatoria contributes to the formation of nitrite Oscillatoria contributes to the formation of nitrite maxima in lakes by assimilatory reduction of nitrate. Algal cultures were grown in Zehnder's mineral medium at pH 8.3, to which potassium nitrate was added. Light was either continuous or intermittent (16 hrs light, eight hrs darkness). With continuous light at 400 lux, nitrite in the medium increased to a maximum of four mg N/l after 30 days, then decreased; after 50 days, only trace days, then decreased; after 50 days, only trace amounts of nitrite remained. With the light-dark cycle, the rate of nitrite accumulation was lower, but the maximum was attained later and was much higher (seven mg N/l). Both nitrite production and algal growth rate were inversely correlated with light intensity. (Lynch-Wisconsin) W79-08817

A DIURNAL STUDY OF THE PHYTOPLANK-TON IN THE EUTROPHIC LAKE LOVO-JARVI, SOUTHERN FINLAND, University Coll. of North Wales, Bangor. School

of Plant Biology.
R. I. Jones, and V. Ilmavirta.
Archiv fur Hydrobiologie, Vol. 83, No. 4, p 494-514, September 1978. 10 fig. 4 tab, 44 ref.

Descriptors: *Lovojarvi(Finland), *Phytoplankton, *Eutrophication, *Vertical distribution, *Methodology, *Photosynthesis, *Analytical techniques, Measurement, Lakes, Finland, Diurnal, Epilimnion, Euphotic zone, Distribution, Primary productivity, Respiration, Stratification, Chlorobull Harden, Chlorobull Harden, Stratification, Chlorobull Harden, Chlorobull Harden, Chlorobull Harden, Chlorobull Harden, Chlorobull Harden, Chlorobull phyll, Hydrogen ion concentration, Carbon radio-sotopes, Light-dark bottle method, Dissolved oxygen, Oxygen demand.

Rather weak diurnal changes in the vertical distri-bution of phytoplankton in the epilimnion of Lovo-jarvi, a eutrophic lake in southern Finland during a 24-hr study 11-12 August 1976, are attributed to water column stability, the small proportion of motile individuals, and the rather shallow euphotic zone. Rates of photosynthesis were considerably underestimated during long experiments in experi-mental enclosures, but no satisfactory solution was found for obtaining daily rates from shorter exposures. Use of the carbon-14 and oxygen methods for measuring photosynthesis gave results which agreed qualitatively, but which compared poorly in terms of quantity. Reliable measurements of net photosynthesis were not possible by either method. impossible to correct carbon-14 results for respiratory losses by using the loss of carbon-14 in the dark to estimate respiration. The water column was strongly stratified both thermally and chemically. Changes in concentration of oxygen and pH during the day were noticeable in surface waters a result of biological activity. The chlorophyll-a content of cells did not appear to vary with time. At the bottom of the euphotic zone a distinct algal community was found which was adapted to the low irradiance through higher cell chlorophyll content. The study day was divided into five periods, with sampling at 9 am, 2 pm, 7 pm, and 10 pm 11 August, and 4 am 12 August. (Lynch-Wisconsin) W79-08818

CALORIC CONTENT AND ELEMENTARY COMPOSITION OF SESTON OF THREE DUTCH FRESHWATER LAKES, Amsterdam Univ. (Netherlands).

Albactusiii Lab. G. M. Hallegraeff. Archiv fur Hydrobiologie, Vol. 83, No. 1, p 80-98, May 1978. 6 fig. 3 tab, 35 ref.

Descriptors: *Trophic level, *Seston, *New phytoplankton, *Caloric, *Barlosche Kolk(Netherlands), *Pool't Hammertje(Netherlands), *Lake Maarsseveen(Netherlands), Netherlands, Lakes, Phytoplankton, Algae, Eutrophication, Weight, Calorimetry, Floral lists, Detrius, Nitrogen, Phosphorus, Indicators, Chemical analysis.

phorus, Indicators, Chemical analysis.

Determination of dry weight, calorica content, and elemental composition of seston in three freshwater Dutch lakes of widely different trophic level showed: (1) good agreement between caloric equivalents calculated from chemical data and directly from microbomb calorimetry; (2) total seston had a strikingly lower caloric content than net phytoplankton; and (3) the nitrogen/phosphorus ratio of seston may be a macroscopic indicator of lake dynamic trophic state. The lower caloric content of the seston is attributed to their high ash content and low organic detritus content. Lakes studied were, in order of decreasing fertility, Pool 't Hammetje, Barlosche Kolk, and Lake Maarsseveen. They were sampled from early spring to late summer 1973-75 at 2-5 week intervals. Dry suspended particulate matter was 3.3-18.8 mg/l in Pool 't Hammetje, 1.2-17.0 mg/l in Barlosche Kolk, and 0.4-1.4 mg/l in Lake Maarsseven. Caloric equivalents of seston ranged 1.44-3.98 cal/mg dry wt, compared with 12-59% fortotal seston. The organic fraction of net phytoplankton contained 4.62-5.74 cal/mg dry wt, and of total seston values derived from field samples to the study of energy flux through aquatic ecosystems should be done with caution. Nitrogen/phosphorus content of seston showed significant variation among lakes and by season. (Lynch-Wisconsin)

BUOYANCY REGULATION BY PLANKTONIC BLUE-GREEN ALGAE IN LAKE MENDOTA, WISCONSIN,

Purdue Univ., Lafayette, IN. Dept. of Biological A. Konopka, T. D. Brock, and A. E. Walsby. Archiv fur Hydrobiologie, Vol. 83, No. 4, p 524-537, September 1978. 6 fig, 4 tab, 20 ref.

Descriptors: *Lake Mendota(WI), *Buoyancy, *Gas vehicles, *Light intensity, *Eutrophication, *Cyanophyta, Lakes, Madison(WI), Wisconsin, Phytoplankton, Algae, Surface waters, Epilimnion, Euphotic zone, Winds, Aphanizomenon flos-aquae, Anabaena circinalis, Microcystis aeruginosa, Filamentous algae, Plant morphology, Plant physiology, Summer, Stratification, Vertical distribution, Photosynthesis, Turgor pressure, Mixing.

Planktonic blue-green algae in eutrophic Lake Mendota (Madison, Wisconsin), studied July-November 1976, lost buoyancy through collapse of gas vehicles during periods of calm water in response to increased light intensity. Blooms of Aphanizomenon flos-aquae, Anabaena circinalis, and Microcystis aeruginosa were present throughout the study period. During windy periods when colonies were mixed throughout the epilimnion, algae are always buoyant due to the gas vesicles. At onset of calm conditions this buoyancy causes the algae to accumulate in surface waters, wherethe algae to accumulate in surface waters, wherethe algae to accumulate in surface waters, where-upon exposure to high light intensities increased photosynthesis and cell turgor pressure; the latter collapses some of the pressure-sensitive gas vesi-cles. All species do not respond equally to effects of light upon buoyancy, and the amount of light required to trigger buoyancy loss is not constant

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Effects Of Pollution—Group 5C

over the summer. Buoyancy regulation sometimes results in subsurface population maxima of Aphanizomenon in the early afternoon. Measurements of buoyancy, cell turgor pressure, and gas vesicle strength after incubation of A. flos-aquae at the lake's surface demonstrates that an increase in cell surgor pressure causes sufficient collapse of the weakest gas vesicles to render the algal filaments nonbuoyant. The gas vesicles are hollow, rigid, pressure-sensitive structures composed of a proteinaceous membrane impermeable to liquid water but permeable to gases; in quantity they can decrease the alga's density to less than that of water. (Lynch-Wisconsin)

LONG TERM STUDIES ON NITROGEN IN TWO RESERVOIRS RELATED TO FIELD FER-TILIZATION,

III.IZATIUN, Ceskoslovenska Akademie Ved, Prague. Hydro-biological Station. L. Prochazkova. Progress in Water Technology, Vol. 8, No. 4/5, p 101-109, 1977. 7 fig, 15 ref.

Descriptors: *Agricultural runoff, *Fertilization, *Slapy Reservoir(Czechoslovakia), *Klicava Reservoir(Czechoslovakia), *Nitrogen, *Water pollution sources, *Czechoslovakia, reservoin (Zeenosiovakia), water pollution sources, *Czechoslovakia, *Watersheds(Basins), Nutrients, Crop production, Fertilizers, Nitrates, Ammonia, Organic compounds, Rivers, Stratification, Seasonal, Discharge(Water).

Discharge(Water).

A highly significant correlation was found between mean nitrate levels in Slapy and Klicaca reservoirs, Czechoslovakia, and the amount of mirogen applied to the watershed in agricultural fertilizers. Nitrate, ammonia, and organic nitrogen concentrations were monitored every three weeks for 16 years in 1310-ha Slapy Reservoir (1959-74), and for 12 years in 70-ha Klicava Reservoir (1959-79); nitrates were the only form which reflected increasing inputs of nitrogen in fertilizers. Annual mean nitrate nitrogen levels showed a strong positive correlation with both the amount of nitrogen used annually per ha farmland and with percentage of farmland in the respective watersheds. Inclusion of water discharge improved the correlation between nitrates and fertilization during winter (October-March), but not during summer stratification. The latter may be due to: (1) higher vegetative activity in summer, (2) the fact that stratification sometimes permits inflowing water to pass through the reseroir without reaching the surface layer, (3) higher evaporation in the watershed in summer and decreased vertical water movement in soil, and (4) possible utilization of nitrate-nitrogen by phytoplankton during photosynthesis, perhaps influenced by the amount of available ammonium-nitrogen. Human nitrogen inputs to Klicava Reservoir are estimated at 2-3 mg/ha/yr, 5-10% of input levels from fertilizers. Mean specific discharge from farmland in the Slapy watershed is estimated at 10-12 kg Nyha/yr. (Lynch-Wisconsin)

THE CONTRIBUTION OF NUTRIENT FROM DIFFUSE SOURCES, Vandkvalitetsinstitutet, Hoersholm (Denmark). K. S. Nielsen, and N. Nyholm. Progress in Water Technology, Vol. 8, No. 4/5, p 111-117, 1977.

Descriptors: *Nutrients, *Nonpoint pollution, 'River flow, *Denmark, *Nitrogen, *Phosphorus, 'Methodology, *Analytical techniques, Rivers, Streamflow, Nutrient flux, Gjeldback(Denmark), Vol-back(Denmark), Norre A(Denmark), Fyn(Denmark), Jylland(Denmark), Regression malysis, Statistical models, Model studies, Equa-tions, Norreaen(Denmark).

Polynomial regression analysis of data on nutrient aputs from nonpoint sources to four Danish watercourses show a linear relationship between river flow and flux of both nitrogen and phosphorus. Satistical models were used in the analysis since to causal models were available. Since the statistical models are area-specific to a certain degree, ther studies should include local measurements.

Watercourses studied were 12-sq km Gjeldbaek (GBK), 11-sq km Vol-baek, and 138-sq km Norre A (Verijum-Alum) in Jyland, and 10 areas in Fyn; monitoring was conducted 1973-74. By simple polynomial regression nutrient flux in g/sec and river flow in cu m/sec as a function of day number (t) was fitted to the equation F(t) = A + Bt + Ct squared. Annual nitrogen and phosphorus in runoff for Jylland are 2980 and 51 kg/sq km in Gjeldbaek, 2170 and 23 kg in Vol-baek, and 990 and 22 kg in Norre A. Water flow for the three areas is 8.1, 4.9, and 10.0 1/sec/sq m. Estimation of the diffuse runoff for watercouses loaded with wastewater often may result in negative contributions from diffuse sources when this term is calculated as the difference between total flux and wastewater flux, possibly due to sedimentation and release from sedimen, incorporation into piant biomass, contributions from rain and groundwater, and denitrification. Two-point measurements in Norreaen showed negative phosphorus differences mainly in spring and summer when average river velocity is low and nutrients are incorporated into plant biomass. (Lynch-Wisconsin)

THE IMMOBILIZATION OF NITROGEN IN A WATER-SEDIMENT SYSTEM BY DENITRIFY-ING BACTERIA AS A RESULT OF NITRATE

ING BACTERIA AS A RESULT OF STRATE RESPIRATION, Agricultural Univ., Wageningen (Netherlands). Dept. of Microbiology. J. F. Van Kessel. Progress in Water Technology, Vol. 8, No. 4-5, p 155-160, 1977. 4 tab, 8 ref.

Descriptors: *Nitrates, *Denitrification, *Bacteria, *Nitrogen, *Sediments, *Sediment-water interface, Immobilization, Respiration, Cycling nutrients, Nutrient removal, Anaerobic conditions, Manure, Agriculture runoff, Thiobacillus denitrificans, Ammonia, Ammonium, Ditches, Organic matter, Water chemistry.

Water chemistry.

A laboratory study of the immobilization of nitrate- and ammonium-nitrogen in surface water by denitrifying bacteria in sediments shows that most nitrate added to the water-sediment samples (95-97%) was removed by volatilization due to denitrification. Sediment samples were collected from two ditches, one carrying effluent from a purification plant for liquid animal manure and containing 3.36% organic matter dry wt (Sediment A), and one draining arable land and containing 1.37% organic matter (Sediment B). Twenty-ml solutions containing different amounts of ammonium chloride or sodium nitrate were added to 20-g sediment samples. The nitrate added to the tubes was consumed after 42 days of incubation for Sediment A and 25 days for Sediment B. Immobilization of labelled ammonium during the incubation periods is increased by the presence of nitrate, which functions as hydrogen acceptor. For Sediment A samples, 97.2% of added nitrate was lost due to denitrification, and for Sediment B sampes, 94.5%; the remaining part was converted into organic matter and ammonia. The quantity of immobilized ammonium nitrogen derived from Sediment A is equal to 7.3% when calculated on the added nitrate nitrogen, and from Sediment B 4.1%. Total nitrogen (nitrate- and ammonium-nitrogen) immobilized due to the addition of nitrate is about 10% of the nitrate-nitrogen added for both sediments. Interaction of water and sediment is a natural and cheap method of removing nitrate from shallow surface waters. (Lynch-Wisconsin)

HUNGARY'S LAKE BALATON: A PROGRAM TO SOLVE ITS PROBLEMS,
Magyar Tudomanyos Akademia, Budapest.
I. Lang.
Ambio, Vol. 7, No. 4, p 164-168, 1978. 6 fig, 7 ref.

Descriptors: *Lake Balaton(Hungary), *Recreation, *Tourism, *Water pollution effects, *Water pollution control, *Eutrophication, *Lake restoration, Hungary, Lakes, Fertilizers, Pesticides, Soil erosion, Water pollution sources, Hydrology, Climate, Algae, Aquatic weeds, Nitrogen, Phosphorus, Nutrient loading, Nutrients, Phytoplankton,

Algae, Zooplankton, Fish, Crustaceans, Regional planning, Research priorities, Planning, Decision making, Governments.

In order to arrest and reverse the deterioration of Hungary's Lake Balaton, continental Europe's largest body of fresh water, a multidisciplinary environmental research program was initiated in 1975. In addition several control measures are projected, including limiting use of lake water to drinking water and recreation, with recreation subordinated to protection of the lake and its environment. All effluents, including treated ones, will be prohibited from entering the lake (and ultimately from the basin), and fertilizer and pesticide use will be curtailed. No new industries will be permitted, in the lake's cathment basin and existing ones will be modermized. Trees will be planted to reduce erosion. The lake has become increasingly eutrophic in the past decade because of: (1) a three-fold increase in tourism from 700,000 guest-days in 1965 to two million in 1975; (2) intensive application of fertilizers and pesticides (DDT) in the basin; and (3) increased transport of sediment to the ake as a result of soil erosion. The lake's shallowness (mean depth three m) and warm summers favor rapid proliferation of algae and aquatic weeds, enhanced by phosphorus and nitrogen loading. Annually 371 tons of total phosphorus 778 tons of total nitrogen enter the lake (6.2 and 13.0 kg/ha of water surface). Research will focus on: (1) factors affecting lake water quality; (2) background for decision-making based on economics, law, and other social sciences; (3) environmental factors affecting recreation and tourism; (4) synthesis of previous research; and (5) a monitoring system. (Lynch-Wissonsin) W79-08824 W79-08824

GEOCHEMISTRY OF SEDIMENT/WATER IN-TERACTIONS OF NUTRIENTS, PESTICIDES AND METALS, INCLUDING OBSERVATIONS ON AVAILABILITY,

ON AVAILABILITY,
D. R. Bouldin.
In: Proceedings of a Workshop on the Fluvial
Transport of Sediment-Associated Nutrients and
Contaminants; Kitchener, Ontario, Canada, 20-22
October 1976; eds, Shear, H. and Watson, A. E. P.
January 1978, International Joint Commission,
Windsor, Ontario, Canada. p 235-244. 1 fig, 2 tab, 1

Descriptors: *Fall Creek Watershed(NY), *Phosphorus, *Soluble phosphorus, *Particulate phosphorus, *Streams, *Water pollution sources, Sediment transport, Sediments, Watershed(Basins), New York, Nutrients, Nutrient loading, Lakes, Reservoirs, Particulates, Streambeds, Streamflow, Geochemistry, Sewage treatment, Point pollution, Nonpoint pollution.

Nonpoint pollution.

Between September 1972 and September 1975 phosphorus fractions and flow were monitored in the 300 sq km Fall Creek Watershed in Central New York and in selected subwatersheds. This paper discusses three aspects of the data: (1) removal from solution of soluble phosphorus inputs from point sources during downstream movement, presumably by reaction with the streambed; (2) a procedure for allocating loading of soluble phosphorus to biogeochemical sources (natural, or background), diffuse sources (associated with human activity), and point sources (from human activity); and- (3) a rationale for the hypothesis that soluble phosphorus will have a major impact on lake biology; while phosphorus associated with particulate matter will have only a minor effect. Water samples were analyzed for molybdate-reactive phosphorus (MRP), total soluble phosphorus (TSP), and total phosphorus associated with particulate matter. High-discharge events are analyzed according to Chow's hydrograph analysis, whic separates flow into: (1) that associated with a base-flow reservoir; (2) that associated with an interflow reservoir, and (3) that associated with surface runoff. MRP in surface runoff is 34-60 mu-1, considerably higher than the six mu-1 estimated for biogeochemical sources. During storms Fall Creek water often contains 500-1000 mu-p-1 associated with particulate matter and 20-40 mu dissolved p/ 1. Evidence is presented showing soluble, not absorbed, phosphorus is the critical factor governing phytoplankton concentrations. (Lynch-Wisconsin)

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Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

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W79-08825

FORMS AND SEDIMENT ASSOCIATIONS OF NUTRIENTS (C.N. AND P.) PESTICIDES AND METALS, NUTRIENTS - P,

It. Logan.

In: Proceedings of a Workshop on the Fluvial Transport of Sediment-Associated Nutrients and Contaminants; Kitchener, Ontario, Canada, 20-22 October 1976; eds, Shear, H. and Watson, A. E. P. January 1978, International Joint Commission, Windsor, Ontario, Canada. p 181-198. 5 fig. 4 tab.

Descriptors: *Nitrogen, *Sediment transport, *Rivers, *Water pollution sources, *Cycling nutri-ents, *Sediments, Nutrients, Eutrophication, Limit-ing factors, Carbon/nitrogen ratio, Nitrates, Am-monium, Nitrites, Ammonia, Nitrous oxide, Bioa-vailability, Nitrification, Denitrification, Sediment-water interfaces, Reviews, Great Lakes, Particu-

Forms, sources, and transformations of nitrogen in fluvial systems are reviewed. Nitrogen forms identified are nitrate, nitrite, ammonium, ammonia, ni-trous oxide, free nitrogen, and particulate nitrogen. Nitrogen sources include: (1) runoff and erosion, Nitrogen sources include: (1) runoff and erosion, (2) tile drainage and seepage, (3) precipitation, (4) sewage, (5) livestock wastes, and (6) processing wastes. About 30-50% of nitrogen loading to the Great Lakes is from point sources, especially wastewater effluents. Sediment nitrogen is a relatively minor source of nitrogen loading to Lake Erie. Important sediment-nitrogen reactions are: (1) nitrogen fixation, (2) immobilization, (3) mineralization-ammonification, (4) nitrification, and (5) denitrification. All organisms have a characteristic carbon/nitrogen ratio, dependent on relative carbon/nitrogen ratio, dependent on relative amounts of biomass protein. Higher plants have ratios ranging from 100:1 to 20:1, while bacteria and other microorganisms have a ratio of about and other microorganisms have a ratio of about 9:1. During decomposition mineral nitrogen may be assimiated or released according to the C/N ratio of the mineral being decomposed. Sedimentitrogen transformations during fluvial transport are described during storm runoff and during winter and summer low-flow runoff. The processes of nitrogen cycling and interchange in sediments are complicated and poorly understood. Very little is known of in-situ rates and factors controlling nitrogen exchange between water and sediments. (Lynch-Wis W79-08826 ch-Wisconsin)

FORMS AND SEDIMENT ASSOCIATIONS OF NUTRIENTS (C.N. AND P.) PESTICIDES AND METALS, NUTRIENTS - P. T. Cahill.

In: Proceedings of a Workshop on the Fluvial Transport of Sediment-Associated Nutrients and Contaminants; Kitchener, Ontario, Canada, 20-22, October 1976; eds, Shear, H. and Watson, A. E. P. January 1978, International Joint Commission, Windsor, Ontario, Canada. p 163-180. 8 fig, 24 ref. Descriptors: *Phosphates, *Total phosphate,

*Orthophosphate, *Particulate phosphate, *Sedi-ment transport, *Path of pollutants, *Reviews, Channel scour, Phosphorus, Particulates, Suspended solids, Lake Erie, Great Lakes, Maumee River Basin(OH), Honey Creek(OH), River basins, Sandusky River Basin(OH), Ohio, Lakes, Rivers, Streams, Nutrient loading, Eutrophication, Sedi-

Studies of phosphate transport 1972-74 showed that: (1) total phosphate (TP) concentration increases with stream discharge, so that the phosphate chemograph parallels the hydrographs; (2) soluble phosphate behaves quite differently from TP; (3) there are often strong correlations between TP and suspended solids levels; (4) mass transport during storms accounts for a great part of total annual phosphate loadings; and (5) past methods of estimating long-term phosphate loadings based on average concentrations severely underestimate annual mass transport. Studies of Lake Erie (1975), Ohio's Maumee River Basin (1976), and Honey Creek in the Sandusky River Basin, Ohio suggest the proper focus of lake eutrophication studies is TP rather than soluble phosphate or orthophosphate. A convenient step is to partition TP into: (1) orthophosphate, and (2) TP minus orthophosphate, orthophosphate, and (2) I'r minus orthophosphate, regarded as a rough measure of particulate phosphate. Honey Creek results illustrate an intermediate level of analysis whih stops short of attempting to specify all causes of observed loading. Unlike TP, orthophosphate does not usually correlate continuous that the continuous control of the continuous control of the continuous control of the co positively with stream discharge (and may be inversely related). Most TP transported during storm flow occurs in association with particulate matter as measured by suspended solids. Honey Creek indicates channel scour is only a minor influence on sediment transport. (Lynch-Wisconsin) W79-08827

FORMS AND SEDIMENT ASSOCIATIONS OF NUTRIENTS (C.N. AND P.) PESTICIDES AND METALS, NUTRIENTS - P,

H. L. Golterman. H. L. Golterman.

In: Proceedings of a Workshop on the Fluvial Transport of Sediment-Associated Nutrients and Contaminants; Kitchener, Ontario, Canada, 20-22 October 1976; eds, Shear, H. and Watson, A. E. P. January 1978, International Joint Commission, Windsor, Ontario, Canada. p 157-161. 4 ref.

Descriptors: "Sediment transport, "Rivers, "Soil erosion, "Sewage disposal, "Agricultural runoff, "Phosphate, "Water pollution sources. Lakes, Rhine River, Meuse River, Sediments, Phosphorus, Bioavailability, Nutrients, Netherlands, Bioassay, Algae, Phytoplankton, Scenedesmus, Chlorophyta, Nitrilotriacetic acid, Apatite, Clays, Iron.

Dutch lakes, mostly in the Rhine and Meuse deltas, receive large amounts of nutrients from these rivers. Of 70,000 metric tons phosphate-phosphorus transported annually by the Rhine, about 7,500-9,000 metric tons accumulate in the Dutch lakes. The lakes receive annual load of about six g/sq m, 50% from the Rhine. River-borne phosphate derives from three main sources: (1) natural erosion, (2) human waste, and (3) agricultural runoff. The (2) numan waste, and (3) agricultural runoit. He Rhine carries about 4,000 tons from erosion, 50,000 tons from human waste, and 1,000-10,000 tons from agricultural runoff per year. During chemical weathering the major part of erosion-derived phosweathering the major part of erosion-derived phosphate is converted into a lattice-bound clay phosphate, apparently available to agricultural crops but not to algae. Phosphate freshly absorbed onto clay is easily available to algal cultures. In unpolluted clays phosphate-phosphorus constitutes about 0.1%. Available sediment phosphate was studied with algal bioassays using Scenedesmus. All sediment promoted good algal growth, though not all phosphate equal to that used by algae could be extracted. I provided a phosphate was entirely pnospnate equal to that used by algae could be extracted. Iron-bound phosphate was entirely available, while apatite availability depended on crystal size. In experiments in an artificial pond, sediments released over one g/sq m PO4-P in six mo, while NTA-extractable phosphate decreased by 50%. (Lynch-Wisconsin) W79-08828

ANTHROPOGENIC INFLUENCES OF SEDI-MENT QUALITY AT A SOURCE, NUTRIENTS: CARBON, NITROGEN AND PHOSPHORUS,

In: Proceedings of a Workshop on the Fluvial Transport of Sediment-Associated-Nutrients and Contaminants; Kitchener, Ontario, Canada, 20-22 October 1976; eds, Shear, H. and Watson, A. E. P. January 1978, International Joint Commission, Windsor, Ontario, Canada. p 81-93. 3 fig. 9 tab. 3

Descriptors: "Carbon, "Nitrogen, "Phosphorus, "Soil erosion, "Sediment transport, "Farm management, "Water pollution sources, "Agricultural runoff, Nutrients, Sediments, Crop production, Particle size, Agriculture, Bioavailability, Manure, Sauvac Audig Festiliars, Testiliars, Testi Sewage sludge, Fertilizers, Fertilization, Phosphates, Cultivation.

Crop production practices significantly affect agricultural runoff and erosion and may also influence nutrient concentration in receiving sediment, either through altering its physical characteristics or al-tering nutrient content of surface soil and hence sediment. Sediment contains a higher proportion of finer particles and organic matter than source soil, and carbon, nitrogen, and phosphorus occur at higher levels in finer particles. Management practices which reduce runoff water carrying capacity will tend to reduce mean sediment particle size and therefore sediment nutrient concentrations. Such practices affect velocity by means of modifying surface roughness and degree of plant residue incorporation. However, practices which reduce sediment loss probably will not reduce nutrient loss proportionately. Crop production generaly re-duces organic matter content of surface soil, deduces organic matter content of surface soil, de-creasing soil stability and increasing runoff. Heavy application (without incorporation) of manure or sewagesludge temporarily increases organic matter content, but also carbon and nitrogen content of runoff, especially application in late fall or winter. Manure and fertilizer should be plowed into the soil to inhibit loss through erosion. Application of phosphorus to surface soil increases extractable phosphorus in sediment and dissolved phosphorus in runoff water. An optimal level of addition exists, above which yield is not increased. (Lynch-Wisabove which yield is not increased. (Lynch-Wis-W79-08829

5D. Waste Treatment Processes

THE SEWERLESS SOCIETY, H. H. Leich. Imiesa, Vol. 1, No. 7, p 15-25, July 1976.

Descriptors: *Sewage treatment, *Waste water treatment, Sewage bacteria, Aerobic bacteria, Sewage disposal, Septic tanks, Biological treatment, Sludge treatment, Environmental sanitation, Sewage sludge, Biodegradation, Domestic wastes, Composting toilets, Biological toilets, Incineration toilets, Fertilizers.

Alternatives to the present sewage treatment system are examined. Adverse effects of the present system include: the possible transmission of diseases to water uses downstream, the wasting of large quantities of purified water, large monetary expenditures, accelerated eutrophication of lakes and estuaries, leakage of raw sewage, and build-up of large amounts of sewage sludge, and build-up of large amounts of sewage sludge. The solution to the problem seems elementary: body wastes should not be put into the public water supply, and sewage disposal systems should be decentralized. At least seven different types of sewerless toilets are on the market or under development. These include incinerating, biological, composting, and oil-flushed toilets, household collection systems, vacuum systems, and aerobic tanks. Some of these vacuum systems, and aerobic tanks. Some of these systems require no electricity, gas, or pumped-in water; others require the use of one or more. Better use of centralized sewage sludge is being investigated. Dried and composted, the sludge serves as fertilizer; experiments are piping liquid sludge to farmlands and forests where it is sprayed as fertilizer. Sludge can also be used for methane production. Because they are more economical and production. Because they are more economical and ecological than sewerage systems, sewerless systems are getting more attention. In the future, U.S. agencies should take a more positive view of new techology, and testing and evaluation programs should be carefully monitored. (Schaefer-IPA) W79-08505

NGODWANA PULP MILL AND THE ENVI-RONMENT,

Sappi Fine Papers, Ngodwana (South Africa). D. Pauw. Environment RSA (Pretoria), Vol. 5, No. 3, p 1-2, March 1978. 1 fig.

Descriptors: *Pulp wastes, *Water pollution control, *Irrigation programs, Pulp and paper industry. Waste water(Pollution). Water pollution sources, Organic wastes, Sulfur, Waste water disposal, Irrigated land, Water management(Applied). outh Africa, Odor, Air pollution

The environmental impact of the Ngodwana mill of Sappi Fine papers since its establishment in 1966 is examined. No effluent from the mill must reach the Elands River so the company decided to irriThe efflue and highly countered the effluer veld denu elected a s adde in the efflu ed; today kikuyu. Se The secon constructe dorous g ame hav through the IPA) W79-0852

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Waste Treatment Processes—Group 5D

gate the effluent onto its own agricultural lands. The effluent was initially of an enormous volume and highly mineralized. Severe problems were encountered when the virgin veld was irrigated with the effluent; natural cover was eliminated and the veld denuded. A hard crust formed on the soil; was selected as the most salt-resistant crop. Gypsum was added to the soil to compensate for the sodium in the effluent. Five hectares were originally planted; today Ngodwana has 53 hectares planted to kituyu. Several hundred cattle graze on the fields. The second effluent problem of the mill was odor emission from sulfur. A gas burner designed and constructed by the mill oxidizes the concentrated odorous gases. Restrictions on hunting and snaring game have produced gratifying results: the bush buck, duiker, and rheebuck once again roam freely through the township gardens at night. (Schaefer-IPA)

DESIGN FOR PRETREATMENT - LAND AP-PLICATION OF INDUSTRIAL WASTES, North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering. M. R. Overcash, and D. Pal. In: Water Pollution Control in Developing Coun-tries, Proceedings of the International Conference held at Bangkok, Thailand, Feb 21-25, 1978. p 469-474. Asian Institute of Technology, Bangkok. OWRT B-100-NC(5). 14-34-0001-7173.

Descriptors: Wastewater management, *Industrial wastes, *Land application.

The methodology for the design of land application systems for a variety of waste sources is delineated. This approach accents the site-specific nature of land-based treatment, a factor which must be continually emphasized. Identification of the land limiting constituent (LLC) in each waste, determination of requisite land system costs, evaluation of costs for effective pretreatment for the LLC, and an economic balance of pretreatment-land application are the steps in design of a total system. The advantages of utilizing plant-soil systems for waste treatment are improved public health and water quality at lower costs, lower energy usage, agriculturally-based operation and maintenance requirements, and increased location sites for industrial development. (Kiger-NC) W79-08526

BIOLOGICAL ACTIVATED CARBON...A
MYTH OR A PROMISING REALITY,
Societe Lyonnaise des Eaux et de l'Eclairage
(France).
F. Fiessinger.

Aqua, No. 2, p 5-7, 1979. 2 fig, 4 ref.

Descriptors: *Activated carbon, *Biologically activated carbon, *Water purification, Granular activated carbon, Water treatment, Water quality control, Trace elements, Water chemistry, Carbon, Adsorption, Organic compounds, Ozone, Granules, Biological treatment, Carbon filters, Filtration

Biologically activated carbon (BAC), a very promising treatment associated with granular activated carbon (GAC) which optimizes biological activity is examined. With bioactivity, GAC creates a center of high microbial activity which makes it far more effective than a mere adsorbent; the amount of organic matter eliminated is increased up to 200% and the carbon's lifetime is considerably extended. Aerobic bacteria largely compose the flora responsible for the biological activity of activated carbon; anaerobic organisms may also intervene. Bacteria are attached mainly to the exterior surface of the carbon granules. Contact time is a crucial parameter; efficiency of bacterial activity increases with the length of time. Bed depth and ate of filtration are also important parameters for efficiency. Apparently, biological activity by itself is not sufficient for maintaining indefinitely a high evel of efficiency of the carbon. Preozonation has been useful as a pretreatment for GAC. Ozonation been useful as a pretreatment for GAC. Ozonation transforms organics into more readily biodegradable substances and hence its overall effect is extremely positive. Elimination of natural organic

acids is better with the combination of ozonation and filtration through GAC than by treatment with either. BAC also facilitates the reduction of ammonia, thereby representing a viable alternative to prechlorination. (Schaefer-IPA) W79-08591

EXPERIENCE IN SWITZERLAND WITH ACTIVATED CARBON FILTRATION AND THE ACTIVATED CARBON REGENERATION,

M. Schalekamp. Aqua, No. 2, p 8-12, 1979. 13 fig.

Descriptors: *Activated carbon, *Water purifica-tion, *Water treatment, Switzerland, Water quality control, Lakes, Potable water, Carbon, Adsorp-tion, Carbon filters, Filtration, Cost analysis, Con-

In Switzerland, activated carbons are principally used for the removal of organic substances and oxidizing agents, such as chlorine. Since the good efficiency of most activated carbons decrease with oxidizing agents, such as chlorine. Since the good efficiency of most activated carbons decrease with time, they must be regenerated or replaced. Activated carbons can be efficiently used as a second layer for rapid or slow filtration systems. Backwashing activated carbons twice a week prevents reinfection; no number of germs higher than 50 per cu cm could be measured in the lake water works of Lengg. The regeneration oven at Lengg is installed in the supplies works and employs a fluid bed process. This process has shown the lowest loss of carbon of all available processes; the effectiveness of regeneration is excellent. The regenerated carbon is slightly less effective than the new. Construction costs for the 12 activated carbon filters with a total area of 528 sq m and a daily output of 25,000 sq m totaled over \$4.26 million Swiss Francs, not including the costs of the regeneration plant. The daily capital cost per cu m capacity for filtration is \$17; capacity for whole lake water treatment costs \$170 daily/cu m. Including 10% amortization and 6% interest, construction cost of the regeneration plant and transfer installations is \$160,000 Swiss Francs annually. Water output is 40 million cu m/yr. Treatment costs at Lengg total \$0.13 per cu m; total cost for filtration is \$0.016 per cu m/yr. (Schaefer-IPA)

INTERNATIONAL RESEARCH ON ACTIVAT-ED CARBON IN WATER TREATMENT, Water Research Centre, Medmenham (England). Medmenham Lab.

R. A. Hyde. Aqua, No. 2, p 13-19, 1979. 2 fig, 14 ref.

Descriptors: *Activated carbon, *Granular activated carbon, *Water purification, Water treatment, Water quality control, Trace elements, Water chemistry, Carbon, Adsorption, Organic compounds, Granules, Pesticides, Trihalomethanes, Chlorophenyls, Carbon filters, Filtration.

Research into the use of activated carbon for the removal of organic compounds from potable water supplies is examined. Use of granular activated carbon (GAC) has increased since regeneration technology has enabled the exhausted material to be reactivated and reused; also it offers a more reliable barrier than powdered activated carbon against trace levels of organic compounds. Over 700 organic compounds have been identified in drinking water; 22 of these are known or suspected carcinogens. The presence of trihalomethanes in water supplies is widespread. Using some or all of the parameters which may influence the ability of the activated carbon to remove organics from the parameters which may influence the ability of the activated carbon to remove organics from water, models have been developed in an attempt to predict the performance of GAC. GAC has successfully controlled taste and odor in many studies. For trace organics removal, a knowledge of the organics present and the behavior of the selected carbon is necessary. Chlorophenols and phenylamide and chlorinated pesticides are strongly absorbed by GAC; trihalomethanes are not strongly absorbed and investigations have studied the removal of their precursors. Bed design and the removal of their precursors. Bed design and plant operations can influence the performance of GAC filters. Biologically activated carbon necessitated reduced carbon quantities for dissolved organic carbon removal. Carbon can be regenerated thermally, chemically, and biologically; a new ap-proach to regeneration uses super critical carbon dioxide. (Schaefer-IPA) W79-08593

ADSORPTION OF TEXTILE DYES FROM AQUEOUS SOLUTION BY ACTIVATED CARBON FROM PEANUT HULLS,

Georgia Inst. of Tech., Atlanta. School of Chemical Engineering. W. R. Ernst.

W. R. Ernst.

Available from the National Technical Information
Service, Springfield, VA 22161 as PB-298 638,
Price codes: A05 in paper copy, A01 in microfiche.
Environmental Resources Center, Georgia Institute of Technology, Atlanta Project Completion
Report No. ERC 01-79, January 1979. 85 p, 15 fig,
15 tab, 60 ref, 1 append. OWRT A-069-GA(1).

Descriptors: *Activated carbon, *Peanuts, *Activated carbon from peanut hulls(ACFH), Adsorption, Water pollution, Water treatment, Sawdust, Sludge, Bagasse, Dyes, Textiles, Pinebark, Waste water treatment.

water treatment.

The effects and production of activated carbon from peanut hulls (ACPH) were studied. Activated carbons have been effectively used to remove residual textile dye from wastewater. Three dyes, direct orange (DO), acid red (AR), and basic yellow (BY) were studied. For each dye, the effectiveness of the activated carbon was highest for carbon produced from peanut hulls and lowest for carbon produced and bagasse) varied among dyes. Percent dye removal from aqueous solution indicated the following optimum operating conditions for producing ACPH in a laboratory: pyrolysis and activation temperature = 700C, pyrolysis time = 1 hour, activation time = 2 hours, and water rate = 0.65 gm/hr/gm peanut hulls. Overall ACPH yield is about 25% at these conditions. Although each dye behaves differently, ultimate absorption capacity is affected by pH. Isotherm experiments showed that laboratory produced ACPH could remove color from dye solutions to yield residual color concentration as low as those achievable by a high quality commercial carbon. (Schaefer-IPA) W79-08607

PROCEEDINGS OF THE 24TH ONTARIO IN-DUSTRIAL WASTE CONFERENCE, HELD MAY 30-JUNE 1, 1977, TORONTO, CANADA. Ministry of the Environment, Ontario, (1977). 371 p, 25 fig, 7 tab, 8 ref.

Descriptors: *Industrial wastes, *Waste water treatment, *Oxidation, *Activated carbon, Environmental effects, Mine water, Chemical wastes,

Nineteen papers were presented at the 24th Ontar-io Industrial Waste Conference. Delegates attend-ed from nine of Canada's provinces and six states. Papers which dealt with industrial waste water treatment included: a discussion of a biological oxidation treatment facility for a high saline waste oxidation treatment facility for a night saline waste stream, a discussion of an activated carbon pretreatment system for a chemical plant, a cold mill waste treatment plant description, the description of a waste water treatment plant at a nickel mine, and a discussion of the environmental effects of expansion of a pulp mill. (See W79-08702 thru W79-08706) (Small-FRC) W79-08701

AQUEOUS EFFLUENT TREATMENT AT THE SUDBURY PROCESSING COMPLEX OF INCO LIMITED,

International Nickel Co. of Canada Ltd., Sudbury (Ontario). Ontario Div.

In: Proceedings of the 24th Ontario Industrial Waste Conference, held May 30-June 1, 1977, Toronto, Canada. p 130-154, 1977. 3 fig. 1 tab. 2

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Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

Descriptors: *Mine water, *Mine wastes, *Waste water treatment, *Neutralization, *Settling basins, Treatment facilities, Nickel, Copper, Iron, Hydrogen ion concentration, Suspended solids.

The development of an environmentally sound new tailings disposal facility at the Copper Cliff, Ontario nickel mine is outlined. Various waste waters were investigated including urban runoff, mine waste waters, plant runoff, and tailing decant. Laboratory and pilot plant studies on treatment processes indicated that neutralization and clarification. processes indicated that neutralization and clarification were promising processes. The Copper Cliff Creek waste water treatment plant which w sultimately built is described, and treatment results for the first year of operation are presented. The clarifiers feature internal sludge recirculation and the treated water is returned to the natural water course. Effluent quality varied in the following ranges depending upon season: pH 9.5, total Cu 0.1-0.2 mg/liter, total Ni 0.4-0.5 mg/liter, total iron 0.8-1.2 mg/liter, and suspended solids 11-15 mg/liter. (See also W79-08701) (Small-FRC) W79-08703

OPERATION OF A COLD MILL WASTE TREATMENT PLANT,
Dominion Foundaries and Steel Ltd., Hamilton

Dominion Foundaries and Steel Ltd., Hamilton (Ontario). Pollution and Monitoring. G. H. Rupay.

In: Proceedings of the 24th Ontario Industrial Waste Conference, held May 30-June 1, 1977, Toronto, Canada. p 155-173, 1977. 4 fig, 4 tab.

Descriptors: *Industrial wastes, *Metallurgy, *Waste water treatment, *Oily water, *Costs, Acid, Alkaline water, Treatment facilities, Performance.

A primary treatment method for cold mill wastes of the Dominion Foundries and Steel, Limited, of Hamilton, Ontario, is described. The plant process and equipment are described, and some of the problems encountered are discussed. The waste treatment system consists of oil emulsion treatment, acidic and alkaline solution treatment, and sodium dichromate solution treatment. Problems include the fact that the oil recovered has been of lower quality than expected, and that oily sludge has built up in several places. Poor thickner oper-ation and problems in the ion exchange system also occurred. There were also some construction problems. The treatment plant and collection net-work cost about 57 million. The primary treatment work cost about 5 minlion. The primary treatment of cold mill waste water by this method cost about 90 cents per 1000 US gallons. The plant meets effluent discharge specifications and tests indicate that a re-usable oil can be produced. (See also W79-08701) (Small-FRC) W79-08704

DESIGN AND OPERATION OF AN ACTIVATED CARBON WASTEWATER PRETREATMENT SYSTEM,

Uniroyal Chemical, Elmira (Ontario). K. C. Bradley.

Hair. Proceedings of the 24th Ontario Industrial Waste Conference, held May 30-June 1, 1977, Toronto, Canada. p 174-193, 1977. 11 fig, 2 tab, 4 ref.

Descriptors: *Activated carbon, *Chemical wastes, *Treatment facilities, *Costs, Performance, Adsorption, Biochemical oxygen demand, Phenols.

Design, construction, and operation of a carbon treatment plant at the Uniroyal organic chemical manufacturing plant in Elmira, Ontario, are described. Laboratory and pilot tests were conducted on a single counter-current pulsed bed system. The treatment plant consisted of an adsorber and an S treatment plant consisted of an adsorber and an S shaped spent carbon discharge pipe. The wet side started well with few problems, but the furnace and off-gas scrubbing system start-up was much more time consuming. Capital cost of the complete system was \$450,000, and operating costs have been about 20 cents/1b of chemical oxygen demand treated. As operating problems are resolved, it is believed that the system will consistently constraint. believed that the system will consistently generate an effluent BOD of 10 mg/liter or better, phenolic equivalent will be well below the 20 ppb, and effluent quality in general will continue to im-prove. (See also W79-08701) (Small-FRC)

W79-08705

DEVELOPMENT, START-UP AND OPERATION OF A BIOOXIDATION TREATMENT FACILITY FOR A HIGH SALINE WASTE STREAM.

E. A. Sommers.

His: Proceedings of the 24th Ontario Industrial Waste Conference, held May 30-June 1, 1977, Toronto, Canada. p 194-208, (1977).

Descriptors: *Brines, *Chemical wastes, *Industrial wastes, *Oxidation, Biological treatment, Waste water treatment, Recycling, Suspended solids, Filtration, Carbon, Organic compounds.

A biological oxidation plant for treatment of waste water brine at the Sarnia propylene oxide plant of Dow Chemical of Canada is described. The plant runs with a propylene glycol removal level of 90-100% based on feed rates of up to 900 gpm and 100% based on feed rates of up to 900 gpm and initial glycol concentrations averaging 350 ppm. TOC removals of 80% have been realized. Initially plant. A test program is planned to test the effluent for recycling within the plant. There have been no problems with washing salt from waste sludge and the filtration system has also been trouble-free. The only problems are related to levels of susenged. only problems are related to levels of suspended solids in the brine, but after tests, success has been achieved using the flocculator as a secondary clarifier. (See also W79-08701) (Small-FRC)

EVALUATION OF CURRENT DEVELOP-MENTS IN MUNICIPAL WASTE TREAT-MENT

MENT.
Available from the National Technical Information Service, Springfield, VA 22161 as CONF-770108, Price codes: A00 in paper copy, A01 in microfiche. Proceedings of a conference held January 26-27, 1977, Baltimore, Maryland, Johns Hopkins University. Technical Information Center, Energy Research and Development Administration, 1977. 121 p, 33 fig, 23 tab, 64 ref.

Descriptors: *Municipal wastes, *Irradiation, *Disinfection, *Sludge treatment, *Conferences, Biodegradation, Anaerobic digestion, Heat treatment, Viruses, Fertilizers, Pathogenic bacteria.

This symposium was organized to present informa-tion on the use of 137Cs from reactor wastes for the disinfection of municipal sewage sludge. Ten papers were presented, nine on sludge treatment. Other topics besides the irradiation of sludge that were considered include: disinfection by composting of sludge followed by land application; anaerobic digestion or long-term lagooning; the use of uncharged ammonia to inactivate enteric viruses; the fertilizer and nutritive value of thermoradiated sewage sludge; and a general overview of prob-lems in sludge treatment and disposal. (See W79-08708 thru W79-08716) (Small-FRC)

THE ERDA GOAL AND WHY WE ARE HERE, Department of Energy, Washington, DC. Div. of Nuclear Research and Applications. D. C. Bauer.

In: Evaluation of Current Developments in Municipal Waste Treatment, p 1-6, 1977. 1 tab.

Descriptors: *Gamma rays, *Disinfection, *Sludge treatment, *Pilot plants, Sludge disposal, Radiation, Nuclear reactors, Municipal wastes.

The division of Nuclear Research and Applications of ERDA supported a program to investigate the potential for, and to develop the technology of, using gamma radiation from 137Cs to reduce the level of pathogens in sewage sludge. The 137Cs is a waste product of a nuclear reactor. The sludge management problem is discussed including treat-ment and disposal. Gamma irradiation yields biological inactivation as well as enhanced settling rates and dewatering characteristics. Treatment facilities using ionizing radiation are operational at several locations. There is a pilot facility utilizing 60Co for waste water treatment in Burlington,

Ontario; an electron accelerator facility near Boston which treats 2% solids sludge; and a fulls-cale treatment plant in Munich, Germany which also uses 60Co. (See also W79-08707) (Small-FRC) W79-08708

SLUDGE DISINFECTION,
Johns Hopkins Univ., Baltimore, MD. School of
Hygiene and Public Health.
C. W. Kruse.
In: Evaluation of Current Developments in Municipal Waste Treatment, p 7-14, 1977. 2 fig, 6 ref.

Descriptors: *Disinfection, *Sludge treatment, *Sludge disposal, Anaerobic digestion, Sewage la-goons, Environmental sanitation, Oxidation, Municipal wastes

Sludge disinfection processes are reviewed which produce partial or complete disinfection of sludge. Anaerobic digestion or long-term lagooning can reduce the pathogen viability to levels safe for some types of disposal. The destruction of organisms can be furthered by the use of heat in the normal digester range of 32 to 38 C. Digested heat-dried sludge at 375 C is near sterile if protected from postdrying conditions. Some expensive, established heat treatments produce overkill or sterilized sludge or sludge ash. These include the Zimpro wet oxidation system and the Porteus or low-pressure Zimpro system. (See also W79-08707) (Small-FRC) W79-08709

OVERVIEW OF THE ERDA/EPA PROGRAM IN TREATMENT OF MUNICIPAL SLUDGE, Sandia Lab., Albuquerque, NM. H. D. Sivinski.

In: Evaluation of Current Developments in Municipal Waste Treatment, p 15-25, 1977. 4 fig, 3 tab, 12

Descriptors: *Gamma rays, *Disinfection, *Sludge treatment, *Environmental sanitation, Municipal wastes, Laboratories, Research and development,

The Beneficial Uses Program at the Sandia Laboby 137Cs, is described. The radioisotopes are a nuclear waste material. Recent pathogen reduction studies demonstrated that an irradiation dose of 1 Mrad at 23 C with oxygenation is effective reducing the reducing reducing pathogens, except viruses. Combined treatment of 300 krads and 55 C for 5 min with oxygenation reduced bacteria, parasite ova, and viruses to acceptable levels. The laboratory is also involved in treatment facility design. Irradiation of sludge, either liquid or composted and raw or digested, could become an important and economically feasible alternative process in many locations. (See also W79-08707) (Small-FRC) W79-08710

SLUDGE IRRADIATION: BACTERIOLOGY AND PARASITOLOGY, Sandia Lab., Albuquerque, NM.

AND PARASITUDOS., Sandia Lab., Albuquerque, NM. J. R. Brandon, and S. L. Langley. In: Evaluation of Current Developments in Muni-ciple Waste Water Treatment, p 26-39, 1977. 7 fig,

Descriptors: *Gamma rays, *Disinfection, *Sludge treatment, *Bioindicators, Sludge disposal, Oxygenation.

Several types of indicator bacteria were studied in an attempt to establish treatment parameters for the irradiation of sewage sludge both liquid and composted. Also, the effects of irradiation on paraova were determined. Ascaris lumbricoi ova were inactivated at doses as low as 150 krads by 99%. Treatment parameters of 1 Mrad at 23C or 300 krads at 55C with oxygenation were feasible for bacterial inactivation. Under proper conditions, regrowth of pathogenic bacteria can lead to problems. Inactivated parameters for raw sludge will be determined in future studies using Ascaris ova by the measurement of embryonation ratios. Also, there are experiments planned to determine if there

is an effect site ova b 08707) (Sm W79-08711

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Waste Treatment Processes—Group 5D

is an effect of oxygenation on inactivation of para-site ova by radiation treatment. (See also W79-08707) (Small-FRC) W79-08711

A PROGRAM TO STUDY THE INACTIVA-TION OF ENTERIC VIRUSES IN WASTEWATER SLUDGE, Sandia Labs., Albuquerque, NM. Biosystems Stud-

In: Evaluation of Current Developments in Municipal Waste Treatment, p 40-53, 1977. 4 fig. 7 tab, 8 ref.

Descriptors: *Viruses, *Sludge treatment, *Ammo-nia, *Disinfection, Hydrogen ion concentration, Aerobic treatment, Anaerobic treatment, Public health.

The most efficient and economical methods for mactivating enteric viruses present in waste water sudge were determined. Both raw and digested studge contain an agent with cidal activity against enteroviruses whose expression is dependent on pH. This uncharged form of ammonia greatly accelerates the rate of heat inactivation of viruses in studge. This agent probably contributes little toward the inactivation of viruses during anaerobic digestion because anaerobic digestion typically occurs at pH 7, a pH at which ammonia is present as the nonvirucidal ammonium ion. Studge is protective of polio virus against inactivation by ionizing radiation as well as heat. However, the simultaneous application of these two treatments causes loss of viral infectivity at greater than additive nates. This was especially true for samples which contained low concentrations of sludge. (See also W79-08707) (Small-FRC) W79-08712

AGRONOMIC AND ANIMAL FEEDING EVAL-UATIONS OF THERMORADIATED SEWAGE SOLIDS IN NEW MEXICO,

New Mexico Agricultural Experiment Station, Las

G. S. Smith, and B. D. McCaslin. In: Evaluation of Current Developments in Municipal Waste Treatment, p 54-60, 1977.

Descriptors: *Fertilizers, *Sewage sludge, *Disinfection, *Nutrients, *Feeds, Ruminants, Performance, Heavy metals, Crop production, Thermal

The fertilizer value and the nutritive value for ruminants was evaluated of sewage solids disinfected by thermoradiation. The thermoradiated swage solids had a fertilizer value which exceed-ed that of commercial fertilizer in tests on cotton, grain sorgum, and Lehman lovegrass grown in calcareous soil. The benefits of micronutrients such calcareous soil. The benefits of micronutrients such as iron and zinc were evident. Sewage solids compared favorably with cottonseed meal as a supplemental feed for sheep and cattle feel fibrous, maintenance-type diets. There was no evidence of pathology or toxicity in cattle or sheep fed sewage products for up to three months or in rats fed sewage solids at levels up to 50% from weaning to young adulthood. Some heavy metals and trace metals were increased in organs and tissues of animals fed sewage solids for long periods, but the magnitude of the increase had questionable significance. (See also W79-08707) (Small-FRC)

MUNICIPAL SLUDGE MANAGEMENT: PROBLEMS AND RESEARCH AND DEVELOPMENT,

Environmental Protection Agency, Washington, DC. Office of Research and Development. D. J. Ehreth.

In: Evaluation of Current Developments in Municipal Waste Treatment, p 61-76, 1977. 3 fig, 2 tab, 8 ref.

Descriptors: *Research and development, *Projects, *Sludge treatment, *Sludge disposal, *Envionmental effects, Dewatering, Incineration, Land application, Metals, Toxicity, Byproducts.

The Environmental Protection Agency sludge management research and development program is described which encompasses four major technical areas: processing and treatment, utilization, disposal, and health and ecological effects. The program was designed to overcome environmental problems of sludge utilization and disposal options. The present state of the art is adequate to dewater sludge, and incineration is well established except for air emissions control. Coincineration of sludge plus solid waste and pyrolysis technology are just emerging. Technological gaps which exist and are being studied include the high costs of sludge processing and disposal, and methods for converting sludge into beneficial by-products. Other problems include limited confidence in the efficacy of local industrial pretreatment programs for metals removal, lack of understanding of the risks of land application, and lack of sure methods for the removal of toxicants at the treatment plant. (See also W79-08707) (Small-FRC)

COMPOSTING RESEARCH AND DEVELOP-

National Agricultural Research Center, Beltsville, MD.

In: Evaluation of Current Developments in Municipal Waste Treatment, p 83-92, 1977. 3 fig, 1 tab, 8

Descriptors: *Biodegradation, *Sludge treatment, *Sludge disposal, *Land management, *Aeration, Heavy metals, Pathogenic bacteria, Fertilizers.

Land application of sewage sludge stabilized by composting is discussed. Most of the problems associated with land application such as heavy metal, organic chemical, and pathogen content, can be resolved by composting. The aerated pile method developed by the U. S. Department of Agriculture composts both raw and digested sewage sludges. Sludge is transformed into compost in about three weeks. Odors are eliminated, and nathogenic organisms are destroyed. The finand pathogenic organisms are destroyed. The fin-ished compost can be used as a low analysis fertilished compost can be used as a low analysis fertilizer and soil conditioner. It is easy to store and handle and can be uniformly spread on land. This method can avoid the problems caused by strict limitations on disposal of sludge by incineration, fresh water dilution, and ocean dumping. (See also W79-08707) (Small-FRC) W79-08715

COST AND EFFECTIVENESS COMPARISONS OF VARIOUS TYPES OF SLUDGE IRRADIA-TION AND SLUDGE PASTURIZATION TREATMENTS,

Sandia Labs., Albuquerque, NM. Isotope Applica-

M. F. Morris.

In: Evaluation of Current Developments in Municipal Waste Treatment, p 93-106, 1977. 10 fig, 5 tab, 5 ref.

Descriptors: *Irradiation, *Heat treatment, *Disinfection, *Sludge treatment, *Costs, Pathogenic bacteria, Performance, Viruses.

Irradiation, thermoradiation, and thermal pasturization are compared as methods for destroying pathogens in liquid sewage sludge. Thermal pasturization is the most effective treatment. Themoradiation destroys viruses, but irradiation is effective except for viruses. Process costs are analyzed and compared. Using conventional accounting and current fuel oil prices, thermal pasturization is the cheapest of the three processes. In general, irradiation is cheaper than thermoradiation. With increases in fuel oil prices, irradiation may become economically more attractive. Presently irradiation is technically feasible but only marginally cost effective. (See also W79-08707) (Small-FRC) W79-08716

AN ASSESSMENT OF THE MIXING PER-FORMANCE OF SEVERAL ANAEROBIC DI-GESTERS USING TRACER RESPONSE TECH-

Ontario Ministry of the Environment, Toronto. Pollution Control Branch.

J. Smart. Research Publication No. 72, 1978. 68 p, 17 fig, 4 tab, 29 ref, 2 append.

Descriptors: *Anaerobic digestion, *Mechanical equipment, *Evaluation, *Design criteria, Performance, Mixing, Efficiencies, Waste water treatment.

ance, Mixing, Efficiencies, Waste water treatment. The mixing characteristics of a typical modern anaerobic digester were assessed by evaluating ten different digesters. The digesters studied represented extremes in physical size, age, and condition, and included most equipment types currently in use. Digesters tested ranged in size from 754 cu m to 7667 cu m and in specific nameplate power from 654 W/1000 cu m to 6561 W/1000 cu m. Digester mixing ranged from 10% to 89% dead space and averaged about 45% dead space. Four of the seven digesters experienced substrate short-circuiting ranging from 18 to 72% of the sludge substrate input. For all ten digesters, observed hydraulic retention times ranged from 18 to 97% of theoretical values and averaged 65%. No relationships were seen between mixing efficiencies and digester sizes, ages and general conditions, types of mixing equipment installed, and specific applied nameplate power. A review of literature data suggested that digesters were generally overdesigned and indicated that maximum digester volume utilization and elimination of substrate short-circuiting by improved design and mixing efficiencies would permit higher applied organic and hydraulic loadings. (Small-FRC) W79-08717

DOMESTIC WASTE WATER DISPOSAL AND NUTRIENT REMOVAL BY SEPTIC TANK -SAND FILTER SYSTEM, Ontario Ministry of the Environment, Toronto. Pollution Control Branch.

N. A. Chowdhry. Report 77, 1978. 24 p, 2 fig, 2 tab, 32 ref.

Descriptors: *Filtration, *Septic tanks, *Sewage treatment, *Nitrogen, *Phosphorus, Domestic wastes, Sands, Soil types, Waste water treatment, Costs, Performance.

A septic-tank-sand filter system was tested which contained a naturally occurring mineral, clinoptilolite, and a waste by-product of bauxite purification, red mud, mixed with sand. The efficiency of removal of BOD and suspended solids was more than 96% even after more than one year. There was no significant effect on the efficiency of phosphorus removal with red mud after treatment by the sand-clinoptilolite can reduce nitrogen content of raw sewage or septic tank effluent by more than 90%. The additional cost for the addition of clinoptilolite to a sand filter serving a four person residence would be approximately \$2,000.00 for ten years. Thus, in a location where a conventional tank-tile field can not be installed, a sand filter is an acceptable alternative. If the soil around the sand filter does not contain silt and clay, red mud can be used to retain phosphorus. Clinoptilolite can be A septic-tank-sand filter system was tested which used to retain phosphorus. Clinoptilolite can be added to the filter to remove nitrogen compounds when necessary. (Small-FRC)

NITRIFICATION IN ACTIVATED SLUDGE PLANTS - GUIDELINES ON SOME OPERATION AND DESIGN ASPECTS, Ontario Ministry of the Environment, Toronto. Wastewater Treatment Section.

A. G. Smith.

Research. Publication.

Research Publication, W62, 1976. Revised July 1977. 97 p, 17 fig, 12 tab, 66 ref.

Descriptors: "Nitrification, "Activated sludge, "Tertiary treatment, "Denitrification, "Design, Biochemical oxygen demand, Regulation, Monitoring, Trickling filters, Sewage treatment.

A review of the current knowledge on the attainment of nitrification in an activated sludge plant presented. A literature search was performed, and data is presented from the Ministry of the Environ-

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Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

ment's nitrification-denitrification studies. The factors which affect nitrification in the activated sludge process are discussed, and optimum process parameters are proposed. Process monitoring facil-ities and techniques are reviewed. Waste water treatability studies are discussed to aid in nitrifica-tion plant design. New developments include designs of nitrification units which may be used as an add-on tertiary system at existing activated sludge plants treating carbonaceous BOD. These units include trickling filters with recycle or rotating biological discs or drums. An increasing number of wastewater treatment facilities are required to achieve nitrogenous oxidation; thus, new de ments in this field are expected. (Small-FRC)

ULTRAVIOLET DISINFECTION OF DOMES-ULTRAVIOLET DISINFECTION OF DOMES-TIC SEWAGE AND STORMWATER - A LIT-ERATURE EVALUATION, Ontario Ministry of the Environment, Toronto. Pollution Control Branch. F. A. Tonelli, R. Duff, and B. Wilcox. Research Paper 2046, 1978. 43 p, 8 fig, 6 tab, 32

Descriptors: *Ultraviolet radiation, *Waste water treatment, *Disinfection, *Reviews, Chlorination, Municipal wastes, Combined sewers, Overflow.

A literature search was performed to assess the present state-of-the-art of the use of ultraviolet radiation in the treatment of waste water from pollution control plants, combined sewer overflows, and storm sewers. Low pressure mercury vapor lamp UV radiation is capable of adequate and consistent disinfection of waters if substances that absorb or hinder the transmission of radiation are not present. UV irradiation of water does not induce toxicity; however, it can potentially change the mutation rate of microorganisms and induce chemical changes in organic contaminants. UV disinfection appears to be a possible alternative to chlorination of terminal disinfection of secondary or higher quality municipal effluent at smaller plants. This has not yet been proven in full-scale installations. There is almost no data available on UV disinfection of stormwater or combined sewer overflow. (Small-FRC) W79-08721

HUMAN WASTE DISPOSAL ON BEACHES OF THE COLORADO RIVER IN GRAND CANYON.

Arizona Univ., Tucson. Dept. of Civil Engineering

Arizona Univ., tucson. Dept. of Civil Engineering and Engineering Mechanics.

R. A. Phillips, and C. Sartor-Lynch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-267 733,
Price codes: A05 in paper copy, A01 in microfiche.
Report CRRP-11, 1977. 79 p, 11 fig, 23 tab, 40 ref.

Descriptors: *Public health, *Coliforms, *Domestic wastes, *Waste disposal, *Waste dumps, Water pollution sources, Recreation facilities, National parks. Beaches.

The potential for public health hazards due to waste burial on beaches, the efficiency of presently used disposal methods, and the feasibility of alternative disposal methods, were investigated for the 20 tons of human waste solids generated by people participating in river trips on the Colorado River. Disposal methods used include burial of the contents of disinfected or untreated holding toilets or dry hole latrines. Fecal coliform levels at the disposal sites in summer were reduced by greater than 99.99% within one month. Low temperatures resulted in lower die-off rates, but few organisms in September dumps survived the winter. The level fecal coliforms on beach surfaces was generally close to or below the minimum detectable density of 0.02 fecal coliforms/g of sand. Improvements in waste disposal practices are recommended. Visi-tors should be educated to waste disposal practices and more latrines and holding toilets should be made available. (Small-FRC)

A REVIEW OF PHOSPHORUS REMOVAL TECHNOLOGY.

Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD. R. S. Ryczak, and R. D. Miller. Available from the National Technical Information

Service, Springfield, VA 22161 as AD-A040 802, Price codes: A04 in paper copy, A01 in microfiche. Report 7706, 1977. 66 p, 1 fig, 1 tab, 146 ref, 4

Descriptors: *Phosphorus, *Trickling filters, *Lime, *Flocculation, *Permits, Regulation, Tertiary treatment, Waste water treatment, Suspended solids, Biochemical oxygen demand.

Phosphorus removal technology is reviewed for waste water treatment because the National Pollutwaste water treatment because the National Pollut-ant Discharge Elimination System requires treat-ment beyond secondary treatment. Department of the Army treatment facilities are primarily small, trickling filter plants. Chemical-biological treat-ment can successfully overcome the trickling filter's poor biological phosphorus removal and meet NPDES permit standards. Also, the addition of a NPDES permit standards. Also, the addition of achemical step can improve removal of suspended solids, BOD, and COD. Chemical addition can occur in the clarifier. It can also occur in an activated sludge process, although this generally is not done in trickling filter systems. Lime, alum, and iron salts are commonly used in phosphorus reduction. A chemical-biological process can produce phosphorus levels of 1.0 mg/liter total phosphorus phorus. Phosphorus removal technology also in-cludes ion exchange, adsorption, reverse osmosis, and electrochemical techniques. (Small-FRC) W79-08723

LAND APPLICATION OF SEWAGE SLUDGE BY CONTINUOUS SUBSURFACE INJECTION OPERATION AND ECONOMICS, National Science Foundation, Washington, DC. Regional Environmental System Div.

Regional Environmental system DIV.

J. L. Smith, and C. P. Houck.

Available from the National Technical Information
Service, Springfield, VA 2216l as PB-267 135,
Price codes: A03 in paper copy, A01 in microfiche.
Report NSF/RA-760504, 1976. 40 p, 4 fig, 14 tab, 9 ref, 1 append.

Descriptors: *Sludge disposal, *Land use, *Application methods, *Economics, *Crop production, Ultimate disposal, Land management, Farm equipment, Costs, Stabilization, Treatment facilities, Design, Transportation.

The ultimate disposal of sewage sludge by continuous subsurface injection is discussed. The subsurface injection system developed at Colorado State University is described, and the economics of this method are examined. Important design factors which affect system economics are described and operating information is given. The Colorado State system can apply up to 8% sludge at rates ranging from 20,000 to 80,000 gal/acre/pass. Sludge is supplied to the injector at approximately 700 gpm through a 4 1/8 inch, 660 ft flexible hose. Costs include costs for in-plant sludge stabilization, costs for transporting sludge from the plant to the application site, and costs for land application by subsurface injection. Stabilization represents about 50% of the total annual sludge costs; thus, the sludge stabilization system should be optimized when designing the waste water treatment facility. Transportation cost are not significant until the plant size approaches 30 mgd. Transportation distance is the important factor. The cost of land and cost of land preparation are the major factors influencing the injection system costs. Potential agricultural returns are relatively minor when compared to total system costs. (Small-FRC) W79-08724

RAPID INFILTRATION OF PRIMARY SEWAGE EFFLUENT AT FORT DEVENS, MASSACHUSETTS,

Army Terrestrial Sciences Center, Hanover, NH. M. B. Satterwhite, G. L. Stewart, B. J. Condike,

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A035 730, Price codes: A03 in paper copy, A01 in microfiche. Report CRREL 76-48, 1976. 34 p, 10 fig, 11 tab, 26

ref, 1 append.

Descriptors: *Sewage treatment, *Infiltration, *Leachate, *Performance, *Groundwater, Leachate, Biochemical oxygen demand, Phosphate, Coliforms, Nitrogen, Municipal wastes.

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Rapid infiltration of unchlorinated primary effluent was investigated as a waste water treatment method in northern climates. Treatment of 5049 cu m/day of domestic sewage was accomplished using Imhoff tanks and 22 rapid infiltration treatment beds. Biweekly sampling and analysis of primary sewage effluent and groundwater in 14 observation wells indicated that primary effluent was renovated to an extent comparable to that achieved by conventional tertiary systems. Groundwater COD was 10 to 20 mg/liter and BOD was 1.0 to 2.5 mg/liter. Organic nitrogen and NH4-N were generally less than 4 mg/liter in the groundwater adjacent to the disposal site; effluent concentrations were 11 to 33 mg/liter and 6.2 to 42 mg/liter, respectively for COD and BOD. Total phosphate in the groundwater was 80% less than Rapid infiltration of unchlorinated primary effluent mg/ltter, respectively for COD and BOD. Total phosphate in the groundwater was 80% less than in the effluent or about 2 mg/liter. Mean chloriform levels in the groundwater were about 200/100 ml, while mean number in the effluent was 32,000,000/100 ml. The treatment beds renovated the primary sewage effluent to levels much better than those achieved with conventional secondary treatment. (Small-FRC) W79-08725

EVALUATION OF HEALTH EFFECTS ASSO-CIATED WITH THE APPLICATION OF WASTEWATER TO LAND,

WASTEWATER TO LAND,
Southwest Research Inst., San Antonio, TX.
D. E. Johnson, J. W. Register, D. E. Camann, C.
H. Millstein, and J. L. Gulinson.
Available from the National Technical Information
Service, Springfield, VA 22161 as AD-A035 453,
Price codes: A06 in paper copy, A01 in microfiche.
Report AD-A035 453, 1976. 115 p, 14 fig, 33 tab, 5
ref.

Descriptors: *Monitoring, *Aerosols, *Sprinkler irrigation, *Waste disposal, *Public health, Microorganisms, Viruses, Climates, Sampling, Sewage

A preliminary environmental monitoring survey was conducted at a secondarily-treated waste water spray irrigation site in Pleasanton, California. The effluent waste water was monitored for inorganic and organic chemical parameters, bacteria, and viruses. The quantities and types of bacteria and viruses in the air around the spray site were also monitored. Recommendations were made regarding further research at the site. At the treat-ment plant, the residence time of the effluent in the ponds should be investigated. The climatic condi-tions seem ideal for the study of health effects, but they are not optimum for the study of aerosol transport. Relatively high levels of bacteria were transport. Relatively lingli levels of bacteria were located. These results indicate problems in sampling and/or analysis as the results are unrealistic. Many of the upwind samples collected were not indicative of background levels of microorganisms. It is recommended that LEAP and AGI samplers be used. (Small-FRC) W79-08726

EVALUATION OF REVERSE OSMOSIS FOR

EVALUATION OF REVERSE OSMOSIS FOR ELECTROPLATING WASTES, Air Force Civil Engineering Center, Kirtland AFB, NM. Water and Solid Resources Div. D. H. Allen, and E. C. Frein. Available from the National Technical Information

Service, Springfield, VA 22161 as AD-A040 213, Price codes: A03 in paper copy, A01 in microfiche. Report AFCEC-TR-76-42, 1976. 41 p, 9 fig, 4 tab,

Descriptors: *Chromium, *Metallurgy, *Reverse osmosis, *Membranes, *Conservation, Industrial wastes, Waste water treatment, Laboratory tests.

Reverse osmosis was evaluated as a process to reduce pollution and increase materials conserva-tion in large Air Force Chrome plating operations.

Waste Treatment Processes—Group 5D

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s a process to ting operations.

Simulated chrome plating solutions were processed by a reverse osmosis unit, and the degree of separation and membrane damage/deterioration was determined. Reverse osmosis was applied to hexavalent chromium in an acidic medium (pH 6.5). Initial tests were made on a tubular, spiral wound, and Permasep membrane to determine which machine was most applicable to the chrome waste stream. The Permasep membrane was chosen for further study. It demonstrated a high salt rejection rate (0.96 to 0.99 reject ratio) and a high product recovery rate (0.59 to 0.70 recovery ratio). A closed system was designed based on the Permasep membrane which resulted in zero discharge of chromium. (Small-FRC)

GAMMA RADIATION TREATMENT OF WATERS FROM LIGNITE MINES, Central Research and Design Inst. for Opencast Mining, Wroclaw (Poland). H. Janiak.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-295 802, Price codes: A06 in paper copy, A01 in microfiche. Report EPA-600/7-79-064, 1979. 103 p, 44 fig, 22 tab, 16 ref, 1 append.

Descriptors: *Gamma rays, *Radiation, *Mine water, *Waste water treatment, *Clays, Suspended solids, Sedimentation rates, Turbidity, Zeta potential Colloids

Gamma radiation was investigated for the purification of waters drained from surface lignite mines. The mine water is polluted with various suspended solids usually including clay, and generally has a high oxygen demand and a high iron content. Under laboratory conditions in a radiation chamber, waters containing colloidal suspensions with high zeta potential and turbidity were subjected to gamma radiation. Doses were employed within the limits of 100-2000 kRad with slow dosing of 200 kRad/hour and fast dosing of 800 kRad/hour. A positive influence of Co-60 gamma radiation was seen on the speed of suspended matter sedimentation beginning with an absorbed dose of 500 kRad. The optimal dose was 1000 kRad. The greatest effect in increased clarification occurred with waters having an appreciable COD. Changes in pH and COD of the treated waters were observed suggesting that a chemical and not a physical process influences the colloidal suspension removal because there were simultaneous small changes in the zeta potential. (Small-FRC) W79-08728 W79-08728

DESIGN AND OPERATION OF AERATED LAGOONS FOR MUNICIPAL WASTEWATER TREATMENT IN COLD CLIMATES, EKONO Seattle, WA.

H Edde

Available from the National Technical Information Service, Springfield, VA 22161 as PB-256 500, Price codes: A03 in paper copy, A01 in microfiche. Report, 1972. 36 p. 14 fig. 21 ref.

Descriptors: *Winter, *Aerated lagoons, *Design criteria, *Capital costs, Treatment facilities, Heat, Frost protection, Operations.

Experience in the design and operation of aerated lagoons in cold climates is reviewed. Special design precautions to control excessive heat loss to design precautions to control excessive heat loss to the atmosphere include deeper basins with a mini-mum of surface area. Influent, cross-over, and ef-fluent lines should be submerged, and aerators often require external heating to prevent icing. One possible alternative is summer aeration but winter chemical treatment. Also, during winter the lower oxygen uptake requirements can be met with a surifiary external in line oxygenation desires an auxiliary external in-line oxygenation device and subsurface mechanical mixing provided to dis-perse the oxygen and biological solids throughout pease the oxygen and biological solids throughout the basin contents. Cold climate sewage treatment plant design criteria are presented. Capital costs were estimated at .7 million dollars for a less than 1 mgd plant to 8 million dollars for a 100 mgd plant (1972 dollars). (Small-FRC)

CHARACTERIZATION OF NONOILY WASTE WATER ON US ARMY LCU 1561, David W. Taylor Naval Ship Research and Development Center, Bethesda, MD. T. H. Voisinet. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A915 496, Price codes: A03 in paper copy, A01 in microfiche. Report 28-737, 1973. 25 p, 8 fig, 2 tab, 3 ref, 2 append.

Descriptors: *Ships, *Liquid wastes, *Waste water treatment, *Water pollution sources, Domestic wastes, Waste storage, Waste water disposal.

Nonoily liquid wastes generated aboard US Army LCU 1561 during normal deployment, were analyzed. These wastes did not include bilge and ballast water. Waste generation rates, and the physical, chemical, and bacteriological characterisphysical, chemical, and bacteriological characteristics of the waste water were determined. Twenty-three grab samples of waste water in the port and starboard holding tanks were collected and analyzed. Wastes accumulated at approximately 150 gal per day and had a concentration approximately five times that of typical domestic sewage. Comparisons are made between the characteristics of the port tank (toilet wastes) and the starboard tank (galley wastes). Efficient shore-based management is recommended for waste treatment and disposal. Anaerobic conditions in the tanks should be avoided. (Small-FRC) ed. (Small-FRC) W79-08731

DEMINERALIZATION OF CARBON-TREAT-ED SECONDARY EFFLUENT BY SPIRAL-WOUND REVERSE OSMOSIS,

Los Angeles County Sanitation Districts, Whittier,

CA.
C. Chen, and R. P. Miele.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB-288 197,
Price codes: A04 in paper copy, A01 in microfiche.
Report EPA-600/2-78-169, 1978. 60 p, 16 fig, 12 tab, 2 ref.

Descriptors: *Reverse osmosis, *Demineralization, *Membranes, *Economics, *Performance, Costs, Maintenance, Hydrogen ion concentration, Effluent streams, Tertiary treatment, Activated carbon, Waste water treatment, Water purification.

Waste water treatment, Water purification.

A 15,000 gpd spiral-wound reverse osmosis plant was operated on carbon-treated secondary effluent at the Pomona Advanced Wastewater Treatment Research Facility. Effective membrane life was determined, and the reliability of the process was determined. The first phase of the study was conducted on a constant feed pressure basis. Adjustment of pH was not practiced for the weekly enzyme-detergent membrane cleaning procedures. During the second phase, there was a constant product water flux rate, and pH adjustment was practiced. Both phases substantiated the fact that the membrane effective life was about one year in demineralizing the secondary, carbon-treated effluent. For membranes with a one year life, the process cost for a 10 mgd reverse osmosis plant would be about 14.9 cents/1000 liters. If membranes had a two year life, costs would be reduced to 10.7 cents/1000 liters. These costs do not include the costs of carbon adsorption pretreatmen and bine disposal, and are based on 1973 prices. (Small-FRC) (Small-FRC) W79-08732

RECOMMENDED DESIGN CRITERIA FOR WASTEWATER TREATMENT AT PROPOSED CONSOLIDATED TACTICAL VEHICLE WASH FACILITY, FORT DRUM, NY, Construction Engineering Research Lab. (Army), Champaign Marchampaign.

Construction Engineering Research Lao. (Army), Champaign, IL.
L. Benson, M. Staub, R. Fileccia, and J. Matherly.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A042 629, Price codes: A04 in paper copy, A01 in microfiche.
Report N-26, 1977. 65 p, 27 fig, 4 tab.

Descriptors: *Design criteria, *Oily water, *Filtration, *Settling basins, *Pilot plants, Waste water

treatment, Industrial wastes, Regulation, Perform-

To determine design criteria for waste water treatment at a proposed consolidated tactical vehicle wash facility, tracked vehicle washrack discharges were surveyed at Fort Drum, New York. Operation of intermittent sand filters in conjunction with a waste water collection and pretreatment system was monitored to verify waste water compliance with Federal regulations. Pilot scale studies provided data on loading rates, depths and characteristics of filter media, waste removal efficiency, and other pertinent information. Specific design calculations are presented including maximum waste water flow, average flow over washing period, waste water characteristics, and sedimentation basin sizing. The treatment components include a sedimentation basin equipped for mechanical free oil removal followed by a flow equalization basin and intermittent sand filtration. (Small-FRC) FRC) W79-08733

SODA ASH TREATMENT OF NEUTRALIZED MINE DRAINAGE, Gwin, Dobson and Foreman, Inc., Altoona, PA. D. A. Long, J. L. Butler, and M. J. Lenkevich. Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 760, Price codes: A05 in paper copy, A01 in microfiche. Report EPA-600/2-77-090, 1977. 64 p, 15 fig, 11 tab, 13 ref, 2 append.

Descriptors: *Mine water, *Neutralization, *Water softening, *Acidic water, *Mine acids, Waste water treatment, Performance, On-site tests, Iron,

The performance of a lime neutralization/soda ash softening process in the treatment of acid mine water was evaluated. The treatment plant located in Altoona, PA, has the capability of treating waters from the Kittanning Run which is acid mine polluted, alone or in combination with waste waters from other sources. The unit process consisted of lime neutralization, aeration, settling, soda ash softening, recarbonation, and filtration. The ash softening, recarbonation, and filtration. The five month study generally indicated that the desired water quality could be achieved. The coal mine drainage had the characteristics of pH 3.0, acidity 160 mg/liter, iron 14.5 mg/liter, and manganese 4.5 mg/liter. Neutralization of the water resulted in a clarified effluent averaging an 85% reduction in iron. The most effective removal of the properties are the statement of the manganese was by the addition of potassium per-manganate to the influent line before neutralization. Effluent quality of 100 mg/liter hardness cost 10 cents/cu m, and treatment to 200 mg/liter hardness cost 9 cents/cu m. (Small-FRC) W79-08734

POTENTIAL APPLICATIONS OF INSOLUBI-LIZED ENZYMES IN WASTE TREATMENT, Princeton Univ., NJ. Dept. of Chemical Engineer-

D. F. Ollis. Available from the National Technical Information Service, Springfield, VA 22161 as PB-252 481, Price codes: A03 in paper copy, A01 in microfiche. Report NSF-RA-T-73-029, 1973. 24 p, 5 fig. 7 tab,

Descriptors: *Sewage treatment, *Enzymes, *Proteins, *Reviews, Solubility, Biological treatment, Hydrolysis, Food processing industry, Industrial wastes, Sludge treatment.

A brief literature survey is presented which establishes the potential for utilizing covalently insolubilized depolymerases to hydrolyze particulate feed streams in waste treatment. The retention of activity of covalently insolubilized biological molecules toward particulate surfaces is established by work on various substrates. Some potential applications of the system are proposed. Potential applications for these doubly particulate reactor systems may include the solubilization of waste stream particulates to regain nutritional content as, for example, in fish protein hydrolysate production. Another possible application is in the pretreatment of bio-

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

logical sludge to render filtering and dewatering properties more ideal for subsequent processing. (Small-FRC) W79_08735

DESIGN CONSIDERATIONS FOR AEROBIC DIGESTERS.

Environmental Protection Agency, Denver, CO. VIII.

Region VIII.

B. A. Hegg, and K. L. Rakness.

Available from the National Technical Information
Service, Springfield, VA 22161 as PB-255 577.

Price codes: A05 in paper copy, A01 in microfiche.
Report SA/TSB-8, 1973. 47 p, 1 fig, 7 tab, 7 ref, 2

Descriptors: *Design criteria, *Aerobic treatment, *Digestion, *Oxygen, *Size, Ultimate disposal, Sludge treatment, Equations, Performance.

Design characteristics are summarized for aerobic digesters which will insure satisfactory results. General information is provided on the process including a process description, design factors, advantages, and disadvantages. Unit sizes are considered with a discussion of design factors, the estimaered with a discussion of design factors, the estimation of digester loading, and example calculations. Oxygen requirements are discussed including efficiency considerations, waste sludge, and mode of operation. The removal of supernatant and tank construction are discussed. Parameters on which the design of systems are based include loading rate, solids residence time, process proceeding the digester, and temperature. Sample calculations are presented on sizing a digester based on influent flow, influent BOD influent TSS, allowable effluent BOD and TSS, and sludge temperature. Oxygen requirements are usually between 1-2 mg/liter and adequate mixing must be provided. Ulti-Oxygen requirements are usually between 1-2 mg/ liter and adequate mixing must be provided. Ulti-mate disposal methods for aerobically digester sludges include drying beds, sludge lagoons, and land application. (Small-FRC) W79-08736

TECHNICAL ASSISTANCE PROJECT FORT COLLINS WASTEWATER TREATMENT FACILITY FORT COLLINS, COLORADO, JANUARY - FEBRUARY, 1973.

Environmental Protection Agency, Denver, CO.

Region VIII.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-255 573, Price codes: A03 in paper copy, A01 in microfiche. Report S and A/TSB - 22, 1973. 25 p, 4 fig.

Descriptors: *Activated sludge, *Evaluations, *Treatment facilities, *Operation and maintenance, Performance, Aeration, Settling basins, Mechanical equipment.

During an operation and maintenance survey of the Fort Collins, Colorado, Wastewater Treatment Plant No. 2, data were collected which indicated that cycles of good quality effluent and poorer quality effluent occurred. Assistance offered by the Environmental Protection Agency caused a series of important physical modifications to be made. All returned sludge was introduced at the head end of each basin. Wasting methods were changed to allow the wasting of smaller amounts of sludge over longer periods of time. Leaky seals in the final clarifier were replaced, and adjustable effluent weirs were put into service to provide flexible ent weirs were put into service to provide flexible oxygen control. A wooden baffle was placed in the collection box at the end of the aeration basins to eliminate excessive turbulence. The return sludge eliminate excessive turbulence. The return studge ports in the clariflers were modified to achieve removal of a uniformly thick return sludge. The modifications minimized the time required to grow and maintain a good activated sludge. (Small-FRC) W79-08737

UPGRADING EXISTING WASTEWATER TREATMENT PLANTS: CASE HISTORIES.
Environmental Protection Agency, Cincinnati,

Available from the National Technical Information Service, Springfield, VA 22161 as PB-259 446, Price codes: A03 in paper copy, A01 in microfiche. Report EPA-625/4-73-005a, 1973. 31 p, 11 fig, 6

Descriptors: *On-site tests, *Treatment facilities, *Evaluations, *Activated sludge, *Trickling filters, Aeration, Phosphorus, Odor, Filtration, Chlorina-

Case histories are presented in which facilities were upgraded through the modification of acti-vated sludge and trickling filter biological processes. Inadequate hydraulic retention or contact time es. Inadequate hydraulic retention or contact time and solids retention time are factors which can limit facility performance. Four case histories are described. The South Buffalo Creek Wastewater Treatment Plant in Greensboro, NC, was upgraded by a project including preaeration, chemical addition for phosphorus removal, special odor-control measures, improved sludge handling, and effluent polishing with deep-bed filters. Suspended solids and BOD removal in excess of 98% are expected. The Livermore Wastewater Treatment Plant in California was upgraded in 1967 and includes preliminary treatment, roughling filters, activated-sludge secondary treatment, and pre- and postchlorination. The plant easily meets standards. The Wards Island Wastewater Treatment Plant in New York, NY, increased capacity to 240 mgd through York, NY, increased capacity to 240 mgd through two plant modifications. The conventional activated-sludge aerators were converted to operate on the step-aeration process, and the flow pattern in the final tanks was changed. A trickling filter plant was upgraded by the addition of activated sludge before filtration. (Small-FRC) W79-08738

WASTE TREATMENT AND DISPOSAL FROM SEAFOOD PROCESSING PLANTS.

Maryland Univ., Cambridge. Horn Point Environ-

Re B. Brinsfield, and D. G. Phillips.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 361, Price codes: A06 in paper copy, A01 in microfiche. Report EPA-600/2-77-157, 1977. 104 p, 38 tab, 16

Descriptors: *Food processing industry, *Shellfish, *Commercial shellfish, *Effluent streams, *Disinfection, Suspended solids, Biochemical oxygen demand, Aerated lagoons, Chlorination, Coliforms, Waste water treatment, Liquid wastes, Industrial

Current waste water treatment and disinfection practices and effluent characteristics were exampractices and effluent characteristics were examined in Maryland seafood processing plants. Randomly selected plants were sampled for effluent from processing of blue crabs, oysters, soft-shell clams, and fish. Effluent was analyzed for settleable solids, total suspended solids, BOD, oil and grease, pH, residual chlorine, phosphorus, nitrate, nitrite, ammonia, total Kjedahl nitrogen, total coliform, and fecal coliform. Oil and grease levels and pH of all the samples met EPA effluent limitations for 1977 and 1983, however, only a few plants were within total suspended solids limits. No plants achieved 1983 BOD limitations and several plants had bacterial levels exceeding standards even with achieved 1983 BOD limitations and several plants had bacterial levels exceeding standards even with high residual chlorine levels. Alternatives to aerated lagoon treatment of the seafood processing effluent were suggested, such as a compact and relatively inexpensive system of aeration, settling, and chlorination; batch biological treatment; and in an inexpensive system of screening, sump pump collection, and chlorination. Disinfection alternatives discussed included ultraviolet radiation and tives discussed included ultraviolet radiation, and ozone. (Lisk-FRC) W79-08739

TRACE ORGANICS VARIATION ACROSS THE WASTEWATER TREATMENT SYSTEM OF A CLASS-B REFINERY,

Argonne National Lab., IL. Energy and Environ-

mental Systems Div.

L. A. Raphaelian, and W. Harrison.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-285 596, Price codes: A09 in paper copy, A01 in microfiche. Report ANL/WR-78-2, 1978. 183 p, 7 fig, 19 tab, 6 ref, 5 append.

Descriptors: *Oil industry, *Organic compounds, *Activated sludge, *Activated carbon, *Filtration, Industrial wastes, Pilot plants, Flotation, Performance, Waste water treatment.

Effluent from the full-scale treatment system at SOHIO's Toledo refinery was sampled to determine performance of the waste water treatment system. The system consisted of a dissolved air flotation unit and an add-on pilot-scale unit consisting of mixed-media filtration and activated carbon columns. Four-day composites of daily samples were analyzed for common waste water parameters and trace organic compounds using capillary-column gas chromatography/mass spectrometry. About 304 compounds were found in the DAF effluent and removal of these by the activated-sludge clarifier and add-on treatment units was estimated. The activated carbon unit removed nonestimated. The activated carbon unit removed non-aromatics better than it did aromatics, while the activated sludge unit was more effective in removactivated studge unit was more effective in remov-ing aromatics. Average removal of organics was greater than 99% for activated sludge, about 0% for mixed media filtration, and less than 1% for activated carbon. Of the less than 1% of trace organics remaining in the final clarifier effluent, 81 wt% were removed by activated carbon. (Small-FRC) W79-08742

DEVELOPMENT OF A SORBENT DISTRIBU-TION AND RECOVERY SYSTEM, Seaward International, Inc., Falls Church, VA. For primary bibliographic entry see Field 4A. W79-08743

DISPOSAL OF AN INTEGRATED PULP-PAPER MILL EFFLUENT BY IRRIGATION, Simpson Paper Co., Anderson, CA. Q. A. Narum, D. P. Mickelson, and N. Roehne. Available from the National Technical Information Service, Springfield, VA 22161 as PB-292 758, Price codes: A07 in paper copy, A01 in microfiche. Report EPA-600/2-79-033, 1979. 133 p, 12 fig, 16 tab. 8 angend.

Descriptors: *Irrigation, *Irrigation systems, *Crop production, *Waste water treatment, *Bleaching wastes, Industrial wastes, Waste water disposal, Pulp and paper industry, Leachate, Water quality, California.

The use of fully treated secondary effluent from the Shasta integrated bleached kraft pulp-fine paper mill (Anderson, California), was investigated for beneficial crop irrigation. Laboratory soil columns, field test plots, and hydrological studies were operated. Construction of a 162 hectare irrigation project began in early 1975, and the first effluent irrigation took place in 1976. Wheat, oats, corn, alfalfa, and beans were grown, and crop yields were in most cases better than the California averages for these crops. The effluent percolate eventually enters the Sacramento River. It is essentially devoid of suspended soils, BOD-5, COD, color, and toxic components. Thus, the all effluent discharged meets the requirements of the Waste Discharge Permit issued by a state agency. The primary problem of control of the composition and movement of groundwater was anticipated and required the implementation of a complex monitor-ing program. (Small-FRC) W79-08744

COMBINED REVERSE OSMOSIS AND FREEZE CONCENTRATION OF BLEACH PLANT EFFLUENTS, Institute of Paper Chemistry, Appleton, WI. Environmental Sciences Div.

. J. Wiley, L. E. Dambruch, P. E. Parker, and H.

A. J. Whey, E. S. Dugal.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-285 912, Price codes: A08 in paper copy, A01 in microfiche. Report EPA-600/2-78-132, 1978. 156 p. 24 fig. 36 tab, 29 ref, 4 append.

Descriptors: *Pulp and paper industry, *Bleaching wastes, *Waste water treatment, *Reverse osmosis. *Freezing, Performance, Recycling, Costs, Water

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Waste Treatment Processes—Group 5D

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ffluent from ft pulp-fine investigated ory soil col-gical studies hectare irri-and the first Wheat, oats, n, and crop he California ent percolate er. It is essen-DD-5, COD, e all effluent agency. The apposition and icipated and olex monitor-

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arker, and H.

PB-285 912, in microfiche. p, 24 fig, 36

y, *Bleaching Costs, Water Reverse osmosis and freeze concentration were evaluated as methods for concentrating bleach plant effluent at three pulp and paper mills. These concentration processes divided the feed effluent into two streams. The clean stream approached drinking water purity in some instances and could be recycled to the mill without serious problems. Virtually all of the dissolved material was present in the concentrate stream. Generally, reverse osmosis removed 90% of the water from a stream containing 5 g/liter of total solids to yield a concentrated stream with 50 g/liter solids. The reverse osmosis concentrate was ruther concentrated of the concentrate was freezing to about 200 g/liter. Thus, each 100 liters of feed resulted in about 2 liters of waste concentrate and 98 liters of relatively clean water. Ultimate disposal of the waste concentrate was not investigated. Economics were estimated based on data from the three mills. Reverse cosmosis alone or in combination with freeze concentration is expensive. in combination with freeze concentration is expensive. Costs range from \$18 to \$27/metric ton of bleached pulp. When fresh water usage was reduced, membrane life was increased and costs were lowered. (Small-FRC) W79-08745

WASTEWATER DEMINERALIZATION BY CONTINUOUS COUNTER-CURRENT ION EXCHANGE PROCESS, Los Angeles County Sanitation Districts, Whittier,

CA:
C. Chen, and R. P. Miele.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB-272 301,
Price codes: A03 in paper copy, A01 in microfiche.
Report EPA-600/2-77-152, 1977. 47 p, 5 fig, 8 tab,
6 ref, 2 append.

Descriptors: *Ion exchange, *Pilot plants, *Demineralization, *Cation exchange, Anions, *Resins, Continuous flow, Dissolved solids, Brines, Costs, Separation techniques, Waste water treatment, Municipal wastes.

A 10 gpm pilot plant, manufactured by Chemical Separation Corporation of Tennessee, was operated in Pomona, California for the demineralization of waste water by continuous counter-current ion exchange. At a total organic solid feed rate of 500-600 mg/liter under steady state conditions the pilot plant achieved 82% total dissolved solids removal. The total dissolved solids removal rate decreased to below that achieved in a two-stage fixed-bed The total dissolved solids removal rate decreased to below that achieved in a two-stage fixed-bed system when the use of an inadayne rinse caused leakage of monovalent cations. Regeneration efficiency for the cation and anion exchangers appeared good in the ion exchange pilot plant. The process generated a brine volume which was about 8% of the product flow and thus achieved a 92% water recovery. Besin losses were expressionately. water recovery. Resin losses were approximately 5% for the cation exchanger and about 15% for the anion exchanger, annually; however, these losses represented less than 5% of the total process cost. For a 10 mgd continuous counter-current ion exchange plant based on the pilot plant results and utilizing carbon treated secondary effluent with an average of 600 mg/liter total dissolved solids, the total cost would be about \$.048/1000 gal and the removal efficiency would be about 82%. (Lisk-EPC) FRC) W79-08750

TOTAL ENERGY CONSUMPTION FOR MU-NICIPAL WASTEWATER TREATMENT, Municipal Environmental Research Lab., Cincin-nati, OH. Wastewater Research Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-286 688, Price codes: A04 in paper copy, A01 in microfiche. Report EPA-600/2-78-149, 1978. 43 p, 7 fig, 8 tab, 25 ref.

Descriptors: *Energy, *Conservation, *Waste water treatment, *Treatment facilities, Construction, Energy budget, Energy conversion, Incineration, Anaerobic digestion, Electric power, Munic-

The quantities of different forms of energy consumed for the collection and treatment of munici-

pal waste water are estimated. A conversion factor of 10,500 Btu/kwh is used to convert heat energy to electrical energy. Total energy consumption ranges from 2300-3700 kwh/mg of waste water treated. Energy used for treatment plant construction and sewerage system construction represents 35 to 55% of the total energy consumed. Energy used for plant operation (65-75%) is predominately electrical. Energy can be conserved during plant operation with the use of highly efficienct aeration devices combined with good maintenance practices. Energy can be recovered from the sludge produced at the plant by anaerobically digesting the sludge and using the digester gas as fuel for the internal combustion engine. Large plants with sufficiently dewatered sludge can recover energy by incineration of the dewatered sludge to produce steam in a waste heat boiler. The steam can then be used as an energy source throughout the plant. (Small-FRC)

UNOX DESIGN INFORMATION FOR CONTRACT DOCUMENTS, Metcalf and Eddy, Inc., New York.

A. A. Thomas.

A. A. Thomas.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-256 385, Price codes: A02 in paper copy, A01 in microfiche. Report, 1972. 22 p, 5 fig.

Descriptors: *Activated sludge, *Design criteria, *Oxygen, *Waste water treatment, *Oxidation, Performance, Pilot plants, Costs, Treatment facili-

The Unox activated sludge process is described which uses gaseous oxygen rather than air to maintain dissolved oxygen in the mixed liquor. This process can meet a much higher mixed liquor oxygen demand than any aerated modification, and can meet the demands of higher BOD loadings in the oxidation tanks. Using a pilot plant at the Middlesex County Sewerage Authority as an example, design data are presented for the oxygenation tanks, final settling tanks, and the cryogenic oxygen process. PSA oxygen generators and oxygen storage facilities are described. Safety preautions are reviewed for pure oxygen use. The use of the Unox process is expected to save about 15% in project costs and annual costs. (Small-FRC) FRC) W79-08752

THE COST OF COLUMNAR DENITRIFICA-TION FOR REMOVAL OF NITROGEN FROM WASTEWATER, National Environmental Research Center, Cincin-nati, OH. Advanced Waste Treatment Research

Lao.

R. Smith.

A vailable from the National Technical Information
Service, Springfield, VA 22161 as PB-256 944,
Price codes: A03 in paper copy, A01 in microfiche.
Report, 1972. 44 p, 10 fig, 13 tab, 5 ref.

Descriptors: *Denitrification, *Effluent streams, *Design criteria, *Capital costs, *Operating costs, Treatment facilities, Activated sludge.

The practicability and cost of columnar denitrifica-tion of secondary effluent were investigated. Design criteria are presented for pressure vessels, pressure vessel piping and controls, pumping facili-ties, and methanol feeding and storage. A detailed cost estimate is made. Columnar denitrification is somewhat more expensive than dispersed floc, but developments in fabrication and design could lead to reductions. Operating and maintenance costs for columnar denitrification are estimated at \$997.658 per year for a 100 med plant, and total capital costs. columnar denitrincation are estimated at 3997,050 per year for a 100 mgd plant, and total capital costs for denitrification in dispersed floc basins downstream of the activated sludge process for a 100 mgd plant is \$4,812,811. These estimates are in 1971 dollars. (Small-FRC) W79-08753

NITRIFICATION OF SECONDARY MUNICIPAL WASTE EFFLUENTS BY ROTATING BIO-

Michigan Univ., Ann Arbor.
J. A. Borchardt, S. J. Kang, and T. H. Chung.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB-285 240,
Price codes: A08 in paper copy, A01 in microfiche.
Report EPA-600/2-78-061, 1978. 138 p, 28 fig, 22 tab, 71 ref, 4 append.

Descriptors: *Nitrification, *Effluent streams, *Trickling filters, *Sewage lagoons, *Biological treatment, Performance, Nitrogen, Ammonia, Nitrates, Pilot plants.

The biological nitrification of two municipal waste plant effluents was studied. The effluents were from a high-rate trickling filter or a flow-through, two-stage, raw sewage lagoon. Both effluents contained nitrogen compounds in the form of organic nitrogen, ammonia, and more oxidized forms including nitrate. Two rotating bio-disc pilot units were designed and added to the effluent end of the two municipal waste plants. Operation of the pilot units was monitored for nitrification efficiency. The high-rate trickling filter effluent results were promising, and the design of an optimum nitrification system is discussed considering pH, alkalinity, loading, staging, and other factors. Attempts to investigate the municipal flow-through lagoon met with problems caused by insufficient ammonia nitrogen and inclement weather. This part of the research was cancelled. (Small-FRC)

BREAKPOINT CHLORINATION ACTIVATED CARBON TREATMENT: EFFECT ON VOLATILE HALOGENATED ORGANICS,
Municipal Environmental Research Lab., Cincinnati, OH. Wastewater Research Div.
J. J. Westerick, M. D. Cummins, and J. M. Cohen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-287 129, Price codes: A05 in paper copy, A01 in microfiche. Report EPA-600/2-78-165, 1978. 78 p, 26 fig, 15 tab, 43 ref, 1 append.

Descriptors: *Pilot plants, *Chlorination, *Halogens, *Activated carbon, *Effluent streams, Tertiary treatment, Adsorption, Water purification, Separation techniques.

Separation techniques.

A continuous-flow pilot plant was used to monitor the production of six volatile halogenated organic compounds during breakpoint chlorination of wastewater for ammonia removal and to determine the efficiency of removal of these compounds by activated carbon. Lime-clarified and filtered trickling filter effluent were treated by chlorination/activated carbon systems. The first chlorination system was located before a two-stage carbon adsorber, and the second was between stages of a second two-stage adsorber. The chloroform concentration was increased from a meidan value of 11 micrograms per liter in the tertiary filter effluent to a median value of 61 micrograms/liter with chlorination. Chloroform production in the chlorination system located after one stage of carbon produced one fourth as much chloroform. Bromodichloromethane was formed in amounts less than 10 micrograms/liter when the filter effluent was chlorinated. Chlorination of the first stage carbon effluent produced lower concentrations of bromodichloromethane during the first month of operation, but later these levels were equal to or greater than those produced by chlorination of the filter effluent. Only very low concentrations of dibromochloromethane, bromoform, carbon tetrachloride, and 1,2-dichloroethane were formed. Chloroform removal was more efficient with a 20 minute empty bed contact time absorber, probably beminute empty bed contact time absorber than with a 10 minute contact time absorber, probably because of competitive effects of more strongly adsorbed organics. (Small-FRC) W79-08755

AUTOTROPHIC DENITRIFICATION USING SULFUR ELECTRON DONORS, Cornell Univ., Ithaca. NY. A. W. Lawrence, J. J. Bisogni, B. Batchelor, and C. T. Driscoll.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-287 345,

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

Price codes: A07 in paper copy, A01 in microfiche. Report EPA-600/2-78-113, 1978. 112 p, 24 fig, 28 tab, 76 ref, 2 append.

Descriptors: *Denitrification, *Municipal wastes, *Nitrates, *Laboratory tests, *Kinetics, Energy, Sulfur, Performance, Continuous flow, Non-uniform flow. Packed beds.

Autotrophic denitrification was investigated as a nitrate removal process for municipal waste water. The microbial kinetics were evaluated, and the process performance of autotrophic microbially mediated denitrification using sulfur electron donors was assessed. In the first experimental phase with continuous flow, slurry type reactors, with elemental sulfur as the electron source, greater than 99.5% nitrate removal was achieved a steady state. In the second experimental phase emsteady state. In the second experimental phase em-ploying semi-continuous flow reactors with thiosulfate or sulfide as electron donors reliable auto-trophic denitrification was obtained. The consumptive ratio for these systems was close to 1.35. In the final experimental phase, packed bed columnar au-totrophic denitrification was investigated. Autotrononopaic denitrification was investigated. Autotro-phic denitrification was possible using elemental sulfur as an electron source. Autotrophic denitrifi-cation appears to be a feasible process, but it should be investigated on pilot scale. (Small-FRC) W79-08756

TREATMENT OF WASTEWATERS FROM AD-HESIVES AND SEALANTS MANUFACTURE BY ULTRAFILTRATION, Abcor, Inc., Wilmington, MA. Walden Div. M. H. Kleper, R. L. Goldsmith, T. V. Tran, D. H. Steiner, and J. Peccevich. Available from the National Technical Information

Service, Springfield, VA 22161 as PB-287 498, Price codes: A12 in paper copy, A01 in microfiche. Report EPA-600/2-78-179, 1978. 121 p, 15 fig, 39 tab. 13 ref.

Descriptors: *Industrial wastes, *Filtration, *On-site investigations, *Separation techniques, *Adhe-sives, Sealants, Waste water treatment, Municipal wastes, Performance, Design criteria.

A demonstration project is described for the treat-ment of effluents from adhesives and sealants man-ufacture to produce water suitable for discharge into municipal sewers. A seven-month field demonstration was performed at the Dewey and Almy Chemical Divison of W. R. Grace and Company in San Leandro, California. Also, preliminary studies were performed of ultrafiltration permeate post-treatment alternatives full scale ultrafiltration permeaters. treatment alternatives, full-scale ultrafiltration per-formance was documented at a Chicago plant, and full-scale treatment system designs and economic projections were developed for plants with waste water flows ranging from 3.8 cu m/day to 75.8 cu m/day. Ultrafiltration was a viable process for separating adhesives and sealants manufacturing waste waters into low-volume and high-volume streams. The permeate had the following average contaminant loadings: 100 mg/liter total freon ex-tractibles, less than 7.4 mg/liter nonpolar extracti-bles, less than 27 mg/liter suspended solids, 0.43 mg/liter free cyanide, 3.6 mg/liter total cyanide, 8900 mg/liter BOD, 36,600 mg/liter COD, 44.6 mg/liter phenolic compounds, and 1.5 mg/liter zinc. This effluent is acceptable for discharge into and cyanide levels. An ultrafiltration system with ozonation or reverse osmosis is proposed to meet all municipal discharge standards. (Small-FRC) W79-08758

REMOVAL OF TOXIC METALS FROM METAL FINISHING WASTEWATER BY SOLVENT EXTRACTION,

Texas Southern Univ., Houston. C. W. McDonald.

C. W. McDonaid. Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 563, Price codes: A02 in paper copy, A01 in microfiche. Report EPA-600/2-78-011, 1978. 16 p, 3 tab, 14

Descriptors: *Industrial wastes, *Metals, *Solvent extractions, +Metallurgy, Chromium, Cadmium,

Zinc, Performance, Waste water treatment, Sepa-

High molecular weight Alamine 336 was used to remove chromium, cadmium, copper, nickel, and zinc from metal finishing waste water. The extracremove chromium, cadmium, copper, nickel, and zinc from metal finishing waste water. The extraction of the metals ions was studied using synthetic solutions and actual finishing waste water samples. Using a 100 to 1 waste water to Alamine-336-xylene solution, chromium, cadmium, and zinc ions were extracted simultaneously and selectively. Copper and nickel were not satisfactorily extracted. Chromium, cadmium, and zinc can be stripped from the organic phase with better than 99.5% efficiency using 4 M NaOH. When the reagent is regenerated and recycled, there is no loss of extraction efficiency. The procedures are rapid, reproducible, and relatively efficient. The high molecular weight amines such as Alamine-336, Aliquat-336-S, Primene JMT, Primene 81R, and Amberlite LA1 were unsatisfactory as extractants. The simultaneous extraction of chromium, cadmium, and zinc may have some promise for adoption on an industrial scale. (Small-FRC)

OPERATIONAL RESULTS FOR THE PISCATAWAY MODEL 5 MGD AWT PLANT,

CATAWAY MODEL 5 MGD AWT PLANT, Environmental Protection Agency, Washington, DC. Office of Air and Water Programs. T. P. O'Farrell, and R. A. Menke. Available from the National Technical Information Service, Springfield, VA 22161 as PB-288 162, Price codes: A06 in paper copy, A01 in microfiche. Report EPA-600/2-78-172, 1978. 92 p, 21 fig, 51 tab. 1 append.

Descriptors: *Tertiary treatment, *Lime, *Filtration, *Activated carbon, *Treatment facilities, Performance, Biochemical oxygen demand, Suspended solids, Phosphorus, Nitrogen, Operating costs,

The operation of a 5 mgd tertiary waste water treatment demonstration plant used to upgrade the quality of effluent from a conventional secondary plant is discussed. The tertiary plant used either two-stage high lime or single-stage low lime fol-lowed by dual-media filtration and granular acti-vated carbon adsorption. The high lime process significantly reduced residuals of BOD, TSS, and phosphorus in the secondary effluent using an average dosage of 257 mg/liter CaO and 18 mg/liter FeCl3. The low lime process produced similar removal of residuals using an average does of 113 mg/liter CaO and 25 mg/liter FeC13. Tertiary treatment did not affect total nitrogen residuals. Regeneration of the tree columns under less than optimum conditions resulted in carbon losses esti-mated at 8 to 10%. The tertiary treatment demon-stration plant had operating costs which ranged from 29 to 36 cents per 1000 gal. Since these costs were obtained during start-up, they are probably unusually high. Efforts to select, train, and maintain a highly competent staff are recommended for optimum plant operation. (Small-FRC) W79-08760

WATER FACTORY 21: RECLAIMED WATER, VOLATILE ORGANICS, VIRUS, AND TREAT-MENT PERFORMANCE, Stanford Univ., CA. Dept. of Civil Engineering. P. L. McCarty, M. Reinhard, C. Dolce, H. Nguyen, and D. G. Argo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-285 053, Price codes: A05 in paper copy, A01 in microfiche. Report EPA-600/2-78-076, 1978. 88 p, 11 fig, 31 tab. 16 ref. 2 append. tab, 16 ref, 2 append.

Descriptors: *Municipal wastes, *Lime, *Chlorination, *Activated carbon, Filtration, *Reverse osmosis, Performance, Organic compounds, Metals, Biochemical oxygen demand, Phosphate, Ammonia, Nitrogen, Viruses, Halogens.

The first one and one-half years of operation of the Water Factory 21, a 0.66 cu m/sec (15 mgd) advanced waste water treatment plant designed to improve the quality of biologically treated municiwaste water so that it can provide injection

water for a seawater barrier system, is described. Processes utilized include lime treatment, ammonia stripping, breakpoint chlorination, filtration, activated-carbon adsorption, reverse osmosis, and final chlorination. The effluent quality was evaluated, and the efficiency of treatment for inorganic, organic, and biological contaminants was determined. Chemical clarification with lime at pH greater than 11.3 removed 60% of COD, 99% of phosphate, and more than 50% of most metals. Ammonia stripping averaged 82% removal of ammonia and reduced the concentrations of low molecular weight and non-polar organics. General COD removal was effected by activated carbon adsorption as was removal of a wide range of organic compounds. Breakpoint chlorination reduced ammonia nitrogen to 1 mg/liter, but resulted in the formation of halocarbons. Reverse osmosis removed 95% of general inorganics and 93%. COD. Only one case of virus was found in the effluent. It was associated with an occasional probeffluent. It was associated with an occasional prob-lem of activated carbon fines in the effluent. (Small-FRC) W79-08761

GRANULAR ACTIVATED TWO-STAGE CARBON TREATMENT,
Los Angeles County Sanitation District, Whittier,

CA.
L. S. Directo, C. Chen, and R. P. Miele.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB-288 438,
Price codes: A04 in paper copy, A01 in microfiche.
Report EPA-600/2-78-170, 1978. 64 p. 24 fig, 17

Descriptors: *Activated carbon, *Adsorption, *Tertiary treatment, *Performance, *Costs, Maintenance, Operating costs, Efficiencies, Filtration, Separation techniques.

The effect of repeated thermal regeneration cycles The effect of repeated thermal regeneration cycles on the adsorption capacity, regeneration loss, and pressure drop buildup of carbon with different particle size was evaluated. Two 6.3 liter/sec (0.15 mgd), two-stage, packed-bed, downflow granular activated carbon plants were operated continuously for 33 months using activated sludge plant effluent which was unfiltered and unchlorinated. For the Filtrasorb 300 system, the average effluent dissolved chemical oxygen demand was 6.4 mg/liter and the average suspended solids concentration was 2.1 mg/liter. These values for the Filtrasorb 400 system were 6.2 mg/liter and 2.0 mg/liter. tion was 2.1 mg/lter. These values for the Filtrasorb 400 system were 6.2 mg/liter and 2.0 mg/liter, respectively. The carbon capacity in the Filtrasorb 300 system decreased about 25% after four absorption cycles which resulted in an apparent steady state capacity of 0.25 lbs COD removed carbon. state capacity of 0.25 lbs COD removed carbon. After three adsorption cycles in the Filtrasorb 400 system, a 23% decrease in carbon capacity occurred. The 300 system showed slightly less carbon capacity that the 400 system, but has lower initial cost, lower pressure loss, and lower regeneration loss. The estimated total treatment cost for a .044 cu m/sec (10 mgd), two-stage carbon adsorption 300 system was 11.52 cents/1000 gal. sorption 300 (Small-FRC) W79-08762

PROCESS DESIGN MANUAL FOR NITROGEN CONTROL

Brown and Caldwell Walnut Creek, CA Available from the National Technical Information Service, Springfield, VA 22161 as PB-259 149, Price codes: A19 in paper copy, A01 in microfiche. Report EPA/625/1-75/007, 1975. 457 p, 129 fig. 91 tab, 419 ref, 2 append.

*Nitrification, Descriptors: *Treatment facilities, Publications, *Chlorination, Ion exchange, Design criteria, Waste water treatment, Municipal wastes.

A design manual was compiled for providing process design criteria for implementing nitrogen con-trol in municipal waste water treatment plants. Data from pilot plant and full-scale installations were used to develop design concepts for the technology. The manual contains design criteria for biological nitrification and denitrification, breakpoint chlorination, ion exchange, and air strippi esses i Case institut (Lisk-l W79-0

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Waste Treatment Processes—Group 5D

stripping. The incorporation of various unit processes into a rational treatment design is described. Case studies of actual treatment systems which instituted nitrogen control processes are detailed. (Lisk-FRC) W79-08763

WASTEWATER MANAGEMENT FOR NEW HOUSING DEVELOPMENT. ADVANCED WASTEWATER TREATMENT TECHNIQUES AND NEW EQUIPMENT.
SCS Engineers, Long Beach, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-279 778, Price codes: A04 in paper copy, A01 in microfiche. Report HUD/RES-1321, 1977. 46 p, 5 fig, 4 tab, 43 ref, 1 append.

Descriptors: *Electrodialysis, *Reverse osmosis, *Filtration, *Chlorination, *Activated carbon, Ozone, Nitrification, Ion exchange, Performance, Costs, Waste water treatment.

The current state of development of ten potential The current state of development of ten potential advanced waste water treatment processes is discussed. These include electrodialysis, reverse osmosis, ozonation, microscreening, multi-media filtration, powdered activated carbon, breakpoint chlorination, selective ion exchange, nitrification, and denitrification. Electrodialysis and reverse osmosis are for the removal of dissolved inorganic solids. They are expensive and have membrane fouling problems. Microscreening and multi-media filtration are in limited use to reduce suspended solids. Air-stripping, breakpoint chlorination, sefiltration are in limited use to reduce suspended solids. Air-stripping, breakpoint chlorination, selective ion exchange, and nitrification are proven technologies. Ozonation and powdered activated carbon are proven effective and cost competitive. All systems have higher capital and operating costs but have potential for meeting current or proposed stringent effluent quality standards. (Small-FRC)

WASTEWATER MANAGEMENT FOR NEW HOUSING DEVELOPMENT TREATMENT AND DISPOSAL ALTERNATIVES FOR DOMESTIC SEWAGE MANAGEMENT. SCS Engineers, Long Beach, CA. Available from the National Technical Information Service, Springfield, VA 22161 as PB-279 777, Price codes: A06 in paper copy, A01 in microfiche. Report HUD/RES-1319, 1977. 24 p, 13 fig, 4 tab, 3 append.

Descriptors: *Domestic wastes, *Waste water treatment, *Sewage disposal, *Sewage treatment, Tertiary treatment, Planning, Performance.

The basic characteristics and volume generation data for domestic sewage are considered in this part of a series on Wastewater Management for New Housing Development. The mechanics of conventional primary, secondary, and tertiary sewage treatment processes are described. Ultimate disposal alternatives are discussed with emphasis on disposal techniques, effluent qualities and reon disposal techniques, effluent qualities and required treatments, and typical regulations associated with each disposal method. Discharge into surface waters, land application, and waste water reuse are considered. The overall capabilities of sewage treatment and disposal alternatives are summarized considering pollutant removals, operational requirements, and reliability. Any of the treatment sequences discussed can be designed for any flow volume, and, with proper maintenance, the life of the system is 20-25 years. (Small-FRC) W79-08766 W79-08766

WASTEWATER MANAGEMENT FOR NEW HOUSING DEVELOPMENT COMPARATIVE EVALUATION OF THE PERFORMANCE OF PACKAGE WASTEWATER TREATMENT SYS-

SCS Engineers, Long Beach, CA.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB-279 779,
Price codes: A05 in paper copy, A01 in microfiche.
Report HUD/RES/1322, 1977. 82 p, 27 fig, 13 tab,

Descriptors: *Treatment facilities, *Mechanical equipment, *Activated sludge, *Trickling filters, Filtration, Adsorption, Costs, Performance, Plan-

A summary of available package waste water treatment equipment is presented along with a discussion of the selection and analysis of optimum conceptual treatment systems. This report is part of a series on Waste Management for New Housing Development. Package plant treatment processes include activated sludge type, trickling filtration and activated sludge, rotating media (Biodisc), and physical/chemical. Tertiary options such as filtration and carbon adsorption are also described. The treatment types are classified to aid contractors in the selection of the best process. For each optimum treatment system, a process flow diagram is included together with a summary of anticipated capital, operational, and maintenance costs. In this section, systems are considered which may not be available as a package plant. (Small-FRC)

NITRIFICATION AND DENITRIFICATION FACILITIES: WASTEWATER TREATMENT.
Environmental Protection Agency, Cincinnati,

OH. Available from the National Technical Information Service, Springfield, VA 22161 as PB-259 447, Price codes: A03 in paper copy, A01 in microfiche. Report EPA/625/4-73/004a, 1973. 34 p, 23 fig, 3 tab, 13 ref.

Descriptors: *Nitrification, *Denitrification, *Waste water treatment, *Kinetics, Mechanical equipment, Treatment facilities, Design criteria.

Nitrification and denitrification in waste water treatment are described and discussed. Factors af-fecting nitrification kinetics are considered includ-ing nitrification population dynamics and oxygen nitrification systems. Investigations of nitrification hitrification systems. Investigations or intrification systems are described including nitrification tanks and settling tanks. Denitrification by suspended growth systems is considered in discussions of nitrification tanks, settling tanks, and sludge. (Small-FRC) W79-08768

EVALUATION OF THE EFFECTIVENESS OF CHLORINATION AT THE LITTLETON WASTEWATER TREATMENT PLANT, LITTLETON, COLORADO, MAY 15-23, 1972. Environmental Protection Agency, Denver, CO.

Environmental Protection Agency, Deliver, Co. Region VIII.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-244 881, Price codes: A03 in paper copy, A01 in microfiche. Report S and A/TSB-3, 1972. 26 p, 8 fig, 3 tab, 2 ref, 2 append.

Descriptors: *Chlorination, *Evaluation, *Coliforms, *Water quality, *Chlorine, Rivers, Water pollution sources, Disinfection.

A study was made at the Littleton, Colorado waste water treatment plant of the effectiveness of chlorination in providing satisfactory disinfection before discharge to the South Platte River. Chlorine residuals downstream from the Littleton outfall were also evaluated. The average daily flow was 4.25 mgd and the length of chlorine contact time was 18 min. The chlorine dosage was adjusted from 3.41 mg/liter to 7.45 mg/liter to determine the effect of various dosages on fecal coliform concentrations at the outfall. Chlorine residuals increased at the outfall and in the river as the chlorine trations at the outfall. Chlorine residuals increased at the outfall and in the river as the chlorine dosage increased, except at breakpoint chlorination which occurred at a dosage of about 5.0 mg/liter. The total fecal coliform concentration at the outfall varied inversely with the chlorine residual at the outfall. Dosages of about 5.0 mg/liter yielded the highest total and fecal coliform concentrations. Under usual conditions at Littleton, the chlorine dosage required to reach the 100 fecal coliform per dosage required to reach the 100 feed conform per 100 ml concentration is about 4.64 mg/liter. A chlorine dosage this high would increase chlorine residual in the river to about 0.1 mg/liter which would be detrimental to fish. A better solution

would be to increase chlorine contact time. (Small-FRC) W79-08770

TECHNICAL ASSISTANCE PROJECT LONG-MONT WASTEWATER TREATMENT FACILI-TY, LONGMONT, COLORADO, MARCH-MAY

Environmental Protection Agency, Denver, CO.

Environmental Protection Agency, Denver, CO. Region VIII.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-255 569, Price codes: A03 in paper copy, A01 in microfiche. Report S and A/TSB-2, 1972. 24 p, 10 fig.

Descriptors: *Activated sludge, *Filtration, *Waste water treatment, *Treatment facilities, *Evaluations, Biochemical oxygen demand, Mu-nicipal wastes, Sludge treatment, Standards.

nicipal wastes, Sludge treatment, Standards.

An operational assistance program was initiated to improve the quality of effluent from the treatment plant in Longmont, Colorado. Through operational changes and control, the effluent BOD concentration was reduced from 70 mg/liter to 50-55 mg/liter. This is not a satisfactory effluent level, and the main limiting factors on the activated biofilier unit were lack of sufficient contact time of the redwood media, lack of variable return mixed iliquor flow, and the large final clarifier. Major plant modifications are necessary to meet the effluent standard of 80% BOD reduction. Until modifications can be made, operational guidelines are recommended. Flow adjustments should be made between the two filters to determine optimum flow. Raw sludge should not be centrifuged. Supernatant should not be returned to the head of the plant until a supernatant layer can be developed. Digested sludge should be centrifuged or drawn into sludge drying beds. Analysis of all plant functions should continue. (Small-FRC)

UPGRADING LAGOONS. Environmental Protection Agency, Cincinnati,

OH. Available from the National Technical Information Service, Springfield, VA 22161 as PB-259 974, Price codes: A03 in paper copy, A01 in microfiche. Report EPA-625/4-73-001a, 1973. 50 p, 20 fig, 10 tab, 27 ref.

Descriptors: *Sewage lagoons, *Design characteristics, *Performance, *Treatment facilities, Dikes, Algae, Biochemical oxygen demand, Maintenance, Operations.

Techniques for upgrading lagoons used in waste water treatment are described, and three case studies are presented. Types of lagoons are described, and operating problems are discussed. A well-designed lagoon will incorporate physical features that minimize upsets, maintenance, and odor problems, and maximize operational flexibility, stability, and BOD removal. These features can be added to existing lagoons to upgrade their performance. Fa-vorable design features include configuration, re-circulation, feed and withdrawal variations, pond circulation, feed and withdrawal variations, pond transfer inlets and outlets, dike construction, supplementation of oxidation capacity, and algae removal. The three cases histories include design characteristics, operating data, and cost data. The systems are located in Sunnyvale, California; Los Banos, California; and Stockton, California. (Small-FRC) W79-08772

EVALUATION OF LEACHATE TREATMENT VOLUME I. CHARACTERIZATION OF LEA-

CHATE, Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W79-08774

SEPARATION OF ALGAL CELLS FROM WASTEWATER LAGOONS EFFLUENTS VOLUME 1: INTERMITTENT SAND FILTRATION TO UPGRADE WASTE STABILIZATION LAGOON EFFLUENT,

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ROGEN formation 259 149, icrofiche. 29 fig, 91

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Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

Utah Water Research Lab., Logan. S. E. Harris, D. S. Filip, J. H. Reynolds, and E. J. Middlebrooks.

Middleorooks. Available from the National Technical Information Service, Springfield, VA 22161 as PB-284 925, Price codes: A09 in paper copy, A01 in microfiche. Report EPA-600/2-78-033, 1978. 168 p, 31 fig, 11 tab, 55 ref, 4 append.

Descriptors: *Filtration, *Sands, *Intermittent streams, *Algae, *Performance, *Regulation, Biochemical oxygen demand, Suspended solids, Nitrogen, Hydrogen ion concentration, Flow rates.

The performance characteristics of the intermittent sand filter for polishing lagoon effluent were evaluated. It was determined if filter effluent could consistently meet the requirements of PL 92-500. Effluent meet the stringent water quality standards, but effluent quality was affected by temperature and hydraulic loading rate variations. Effluent values of less than 10 mg/liter BOD, 10 mg/liter suspended solids, and 5 mg/liter volatile suspended solids were met. Within the filters, organic nitrogen conversion and excellent nitrification took place. Effluent had a nitrite-nitrogen concentration less than 0.10 mg/liter and a pH from 7.1 to 8.5. In general, dissolved oxygen was reduced, and all galg genera were removed by filters with a 0.17 mm effective size filter sand. Intermittent sand filter hydraulic loading rates ranging from 3742 to 5613 cu m/ha.d (0.4 to 0.6 million gal/acre/day) should achieve a high effluent quality, maximum total mass of pollutants removed, and a practical filter run length. (Small-FRC)

ADVANCES IN TREATMENT OF DOMESTIC

Environmental Protection Agency, Washington,

DC. Available from the National Technical Information Service, Springfield, VA 22161 as PB-257 604, Price codes: A11 in paper copy, A01 in microfiche. Report, 1972. 246 p, 83 fig, 54 tab, 84 ref.

Descriptors: *Training, *Personnel, *Domestic wastes, *Waste water treatment, Operations, Coagulation, Activated carbon, Ion exchange, Electrodialysis, Reverse osmosis, Filtration, Aeration.

This is a training manual for courses offered to administrative, professional, and technical personnel involved with the selection, design, and operation of waste water treatment upgrading operations. It is prepared for the reference use of students. Current status and trends in waste water treatment are reviewed in a series of six articles. There are eight articles on the basic principles of unit processes. Improving conventional plant performance is dealt with in nine articles. Basic processes considered include coagulation, carbon adsorption, ion exchange, electrodialysis, reverse osmosis, in-depth filtration, microstraining, and aeration. Sludge disposal by landspreading, and combined industrial domestic treatment for paper miliare two specific topics that are discussed. (Small-FRC)

MERL REPORT OF PROGRESS, 1978.

Municipal Environmental Research Lab., Cincinnati, OH.

nau, Oh. Available from the National Technical Information Service, Springfield, VA 22161 as PB-295 508, Price codes: A05 in paper copy, A01 in microfiche. Report EPA-600/9-79-009, 1978. 83 p, 32 fig, 235 ref

Descriptors: *Laboratories, *Projects, *Research and development, *Waste water treatment, Water treatment, Solid wastes, Dewatering, Costs, Oxidation, Federal government.

This progress report provides up-to-date information about the programs of the Municipal Environmental Research Laboratory. The laboratory is the Environmental Protection Agency's research component for the development of technology, systems, and processes to control and prevent environmental pollution. Three research divisions are

represented: solid and hazardous, waste water, and drinking water. The waste water research division has performed recent work in sludge dewatering. It was found in pilot plant studies that various modes of filter press operation can produce dewatered sludge suitable for incineration at quite advantageous unit costs and with annual savings of millions of dollars. The operation of a new biological treatment method, the deep shaft process, is discussed. Waste water flows into and out of a shaft that can be hundreds of meters deep to produce high oxygen levels at the bottom. This is a high-intensity, high-rate treatment process with reduced sludge production. A third research area in waste water is the concept of treatability of hazardous compounds. Treatability studies consider the molecular characteristics of the compound and remove specific compounds by adsorption, biodegradation, and chemical modification. (Small-FRC)

MANPOWER ANALYSIS: MUNICIPAL WASTEWATER TREATMENT FACILITIES IN

NEW ENGLAND, E. B. Gendel, H. N. Kessel, B. F. Kincannon, R. A. Rosenthal, and A. Lazeroff.

E. B. Gendel, H. N. Kessel, B. F. Kincannon, R. A. Rosenthal, and A. Lazeroff.

Available from the National Technical Information Service, Springfield, VA 22161 as FB-253 305, Price codes: Al0 in paper copy, A01 in microfiche. Report, 1972. 192 p, 51 tab, 7 ref.

Descriptors: *Manpower, *Employment opportunities, *Education, *New England, *Surveys.

Six New England states were surveyed in this manpower analysis of waste water treatment plants made in the summer of 1972. Plant site visits were used to obtain universal coverage of municipal plants in Connecituct, Massachusetts, Rhode Island, Maine, Vermont, and New Hampshire. A questionnaire was devised and used to gather information on existing and future manpower needs in the industry. Information is provided on current job vacancies, separations, New England manpower totals, percentage of civil service workers, percentage of union members, level of education of employees, length of service of employees, percentage of certified workers, earnings, and manpower projections. 1977 manpower projections are given by state. Data on the number and type of training courses available to the operators was also compiled. (Small-FRC)

TECHNICAL ASSISTANCE PROJECT VAIL WASTEWATER TREATMENT FACILITY VAIL, COLORADO, MARCH - APRIL 1973.
Environmental Protection Agency, Denver, CO.

Region VIII.

Available from the National Technical Information
Service, Springfield, VA 22161 as PB-255 257,
Price codes: A03 in paper copy, A01 in microfiche.
Report SA/TSB-21, 1973. 31 p, 4 fig, 2 ref.

Descriptors: *Treatment facilities, *Evaluations, *Biochemical oxygen demand, *Sampling, *On-site tests, Activated sludge, Aeration, Training, Waste water treatment, Performance, Suspended solids.

The Environmental Protection Agency evaluation of the Vail, Colorado, waste water treatment facility is discussed. Various plant deficiencies were observed and initial modifications were made. During a period of technical assistance, plant personnel were taught the proper techniques used in collecting, compositing, and storing waste water samples for BOD-5 and suspended solids and were given instruction in the testing procedures. Prior to technical assistance, the facility was operated with the major emphasis on eliminating sludge bulking. Little sludge bulking occurred but effluent quality was not satisfactory. Modifications were made including the conversion from the contact stabilization mode to the conventional mode of activated sludge operation and the initiation of continuous aerator operation. Other deficiencies were corrected by removing the baffles from the final clarifiers, by changing the location for withdrawing waste or excess activated sludge, and by adjustment and cleaning of the polymer feed equipment. The com-

bination of modifications reduced the clarifier effluent BOD-5 from 110 mg/liter to 45 mg/liter during assistance and to about 30 mg/liter after assistance was completed. Problems with the secondary clarifier prevented the facility from meeting the BOD-5 standard consistently. (Small-FRC) W79-08779

WASTE MANAGEMENT OPERATIONS, SA-VANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA.

Department of Energy, Washington, DC. For primary bibliographic entry see Field 5B. W79-08780

3RD USA/USSR SYMPOSIUM ON INTENSIFI-CATION OF BIO-CHEMICAL TREATMENT OF WASTEWATERS, HELD AT VODGEO HEADQUARTERS, MOSCOW, USSR ON 23-24 AUG 1976.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-266 703, Price codes: A05 in paper copy, A01 in microfiche. Proceedings 1976. Environmental Protection Agency, Washington, DC., 87 p, 11 fig, 29 tab, 30 ref, 1 append.

Descriptors: *Municipal wastes, *Industrial wastes, *Waste water treatment, Oil industry, Mineral industry, Pulp and paper industry, Activated sludge, Nitrogen, Oxygen, Aeration.

The third cooperative USA/USSR symposium on the intensification of bio-chemical treatment of wastewaters was held in Moscow, USSR, at the Vodgeo Headquarters on August 24 through 25, 1976. Fifteen papers were presented dealing with municipal and industrial wastes. Topics include biochemical oxidation kinetics, biological treatment of petroleum industrial wastes, treatment of steel industry wastes, nitrogen control in municipal waste water, oxytanks, treatment of kraft pulp wastes, effects of steroids on biological treatment, activated sludge processing with pure oxygen, treatment of organic chemicals industry wastes, treatment of waste water from wool scouring, improvements in municipal sewage treatment. (See W79-08781

KINETICS OF BIOCHEMICAL OXIDATION, Vsesoyuznyi Nauchno-Issledovatelskii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Moscow (USSR).

(USSR). S. V. Yakovlev, I. V. Skirdov, C. I. Rogovskaya, and V. N. Shvetsov. In: 3rd USA/USSR Symposium on Intensification

and V. N. Sivetsov. In: 3rd USA/USSR Symposium on Intensification of Bio-Chemical Treatment of Wastewaters, held at Vodgeo Headquarters, Moscow, USSR, on August 23-24, 1976. p 4-15, 1976. 15 fig.

Descriptors: *Kinetics, *Biological treatment, *Equations, *Laboratory tests, Carbon, Biochemical oxygen demand, Chemical properties, Chemical reactions, Oxidation.

Biological treatment kinetics were investigated under laboratory conditions. The effect of substrate concentration on the biological treatment rate may be described by the Michaelis-Menton Equation. The Ierusalimsky Equation describes the effect of MLVSS upon the rate of biological treatment. The equation of a bisubstrate reaction with two-stage enzyme substitution describes the joint effect of substrate and D.O. concentrations. A generalized kinetic equation was obtained taking into account the effects of the main components of biological oxidation. An increase in the number of carbon atoms in the substance causes a decrease in the biochemical oxidation rate and an intensification of biological systhesis processes. Process kinetics are affected by the various functional groups available and their position in the molecule. The highest destruction rate is observed when the number of carbon atoms in the molecule is the same and the various functional groups determining chemical properties are available. Experimental data analysis demonstrated the correlation between V max and BOD/COD. (See also W79-08781) (Small-FRC)

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CHEM TREAT WAST! Enviro DC. C A. Cyv In: 3rd of Bioat Vo. August

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CHEMICAL ADDITIONS TO BIOLOGICAL TREATMENT OF PETROLEUM REFINERY WASTEWATER, Environmental Protection Agency, Washington, DC. Office of Water and Hazardous Materials.

De. Office of Water and Hazardous Materials.

A. Cywin.

In: 3rd USA/USSR Symposium on Intensification of Bio-Chemical Treatment of Wastewaters, held at Vodgeo Headquarters, Moscow, USSR, on August 23-24, 1976, p 16-21. 1976, 5 fig, 7 ref.

Descriptors: *Oil industry, *Biological treatment, *Chemical reactions, Colloids, Suspended solids, Neutralization, Oxidation, Coagulation, Filtration, Nutrients.

Chemical additions for the treatment of specific petrochemical wastes during biological treatment are described. The most common methods include neutralization and pH adjustment, coagulation-precipitation, oxidation processes, coagulation/mixed media filtration, colloidal destabilization, and nutrimedia filtration, colloidal destabilization, and nutrients. The unit process within a treatment system should be optimized to remove soluble contaminants by biological processes. Pretreatment will enhance the efficiency of the biological treatment by removing colloidal and suspended matter. Operating and equipment costs are reduced using chemical pretreatment. In the raw waste loads, most of the BOD and COD occurs as colloidal or suspended matter; thus, using chemical pretreatment, an effluent can be produced of drinking water quality. (See also W79-08781) (Small-FRC) W79-08783

THE TRENDS IN INTENSIFICATION IN BIO-CHEMICAL TREATMENT OF HIGH DENSITY WASTEWATER, Leningrad Civil Engineering Inst. (USSR).
S. M. Shifrin, B. G. Mishookov, G. V. Ivanov, and E. K. Goloobovskaya.
In: 3rd USA/USSR Symposium on Intensification of Bio-Chemical Treatment of Wastewaters, held at Vodgeo Headquarters, Moscow, USSR, on August 23-24, 1976. p 22-24, 1976, 2 fig.

Descriptors: *Biological treatment, *Aeration, *Coagulation, *Flotation, *Optimization, Suspended solids, Sludge treatment.

Positive results in the field of biological water treatment intensification were obtained by special preparation of waste water before aeration. Electric flotation coagulation reduced contaminant concentration by reducing suspended solids. Suspended solids were decreased by 95-98%, COD was reduced by 60-70%, and BOD was also reduced. The optimum aeration time was found to be the reverse ratio of sludge concentration. The limits of the sludge dose are determined by feeding or the contamination concentration in the water treated. Thus, the waste water treatment process is treated. Thus, the waste water treatment process is determined not only by the sludge loading but by impurities density in the aeration tank. Usually it is most advantageous to carry out the process at minimum sludge dose. (See also W79-08781) (Small-FRC) W79-08784

STEEL INDUSTRY WASTEWATER TREATMENT USING BIOLOGICAL-CHEMICAL TECHNOLOGY, Environmental Protection Agency, Washington, DC. Office of Research and Development.

DC. Office of Research and Section 1989.

J. Lacy.

In: 3rd USA/USSR Symposium on Intensification of Bio-Chemical Treatment of Wastewaters, held at Vodgeo Headquarters, Moscow, USSR, on August 23-24, 1976. p 25-29, 1976. 7 fig. 5 ref.

Descriptors: *Mineral industry, *Industrial wastes, *Ammonia, *Nitrification, *Denitrification, Waste water treatment, Activated sludge, Anaerobic treatment, Dewatering.

Treatment of steel industry waste water is de-scribed. Basic processing operations result in sus-pended solids, oils, waste acids, ammonia, cyan-

ides, phenols, chlorides, fluorides, sulfides, heavy metals, and heated discharges. Two biological-chemical treatments that can be applied to steel manufacturing waste waters are described in detail: ammonia stripping, and denitrification. Ammonia stripping depends upon four factors: the pH of the wastewater, rate of gas transfer, air-to-liquid requirements, and the hydraulic loading. Crosscurrent ammonia stripping towers are described. The minimum air/liquid loading required to obtain 90% removal is approximately 2000 liters of air/liter of waste water. Biological nitrification of ammonia concentrations as high as 500 mg/liter with greater than 90% removal can be obtained with the single-stage activated sludge process. Two-stage systems can achieve greater than 97% removal. Denitrification systems include anaerobic activated sludge, anaerobic ponds, and upflow anaerobic filters. Technologies to be implemented in the future include: slag and sludge dewatering and disposal, a closed-loop system, electro-membranes during the H2SO4 pickling operation, and a new technology which uses the direct reduction of low grade taconite ore. (See also W79-08781) (Small-FRC) W79-08785

FACILITIES IMPROVEMENT FOR BIO-CHEMICAL TREATMENT OF PETROLEUM REFINERY WASTEWATER, Bashkirian Scientific Research Inst. of Petroleum Refining (USSR). V. Ya. Gerber.

V. Ya. Gerber. In: 3rd USA/USSR Symposium on Intensification of Bio-Chemical Treatment of Wastewaters, held at Vodgeo Headquarters, Moscow, USSR on August 23-24, 1976. p 30-31, 1976.

Descriptors: *Oil industry, *Oily water, *Tertiary treatment, *Activated sludge, *Oxidation, Performance, Biological treatment, Oil, Biochemical oxygen demand, Phenols.

Performance specifications are presented for designing biochemical treatment facilities at refineries and petrochemical plants. Single or two stage treatment systems are recommended depending upon the quality of the waste. The activated sludge units in use are described, and operating data is presented for secondary treatment and advanced treatment. All refineries and petrochemical plants located within the Volga and Urals basins utilize biochemical treatment. The most widely used equipment is activated sludge systems with many feeds and complete mixing. Treatment efficiency of two-step facilities is 10 to 15% better than one-step facilities. For oily water, two-step facilities have a two-step facilities is 10 to 15% better than one-step facilities. For oily water, two-step facilities have a BOD removal of 93-98%, oil removal of 77-86%, and phenol removal of 99-100%. When advanced treatment in oxidation ponds is added, the final effluent has the following composition: COD (mg O2/liter) 60 to 80, BOD (mg O2/liter) 2 to 8, ether-solubles 4 to 8, oil 1 to 2, and phenols 0.0 to 0.002. (See also W79-08781) (Small-FRC) W79-08786

BIOLOGICAL METHODS FOR CONTROL OF NITROGEN IN MUNICIPAL WASTEWATERS, Environmental Protection Agency, Washington, DC. Office of Research and Development.

DC. Office of Research and Development.

W. A. Rosenkranz.

In: 3rd USA/USSR Symposium on Intensification of Bio-Chemical Treatment of Wastewaters, held at Vodgeo Headquarters, Moscow, USSR on August 23-24, 1976. p 32-35, 1976. 4 fig, 2 tab, 5

Descriptors: *Activated sludge, *Nitrification, *Denitrification, *Municipal wastes, Sludge treatment, Biochemical oxygen demand, Nitrogen, Suspended solids, Aerobic treatment, Anaerobic treatment, ment, Pilot plants.

The operating conditions for the activated sludge process were investigated to select conditions which will produce efficient nitrification and deniwhich will produce enterth intrincation and derivitification with the indigenous carbonaceous material in the waste water as the electron donor. At a pilot plant in Washington, D. C., alternate periods of aerobic and an sufficiently low food-to-microorganisms ratios to

ensure a nitrifying population. During nine months of operation the plant operated at a food-to-mass ratio of about 0.1 lb BOD/lb MLVSS/day (0.1 g/g/day). Nitrogen removals varied from 54 to 84%. A full-scale plant evaluation project is also described. BOD and suspended solids removal have been better than 90%, nitrification has been complete, and total nitrogen removal has been in excess of 80% without the addition of organic supplement. (See also W79-08781) (Small-FRC) W79-08787

OPERATION EXPERIENCE OF OXYTANKS, Vsesoyuznyi Nauchno-Issledovatelskii Inst. Vo-dosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Moscow

L. V. Skirdov, V. N. Shvetzov, A. A. Bondarev, B. J. Lurje, and N. G. Bereykina.
In: 3rd USA/USSR Symposium on Intensification of Bio-Chemical Treatment of Wastewaters, held at Vodgeo Headquarters, Moscow, USSR on August 23-24, 1976, p 36-40, 1976, 5 fig, 3 tab.

Descriptors: *Oxygenation, *Oxygen, *Activated sludge, *Treatment facilities, Biological treatment, Performance, On-site tests, Ammonia, Costs, Air

The oxytank system, which utilizes pure oxygen and high concentrations of activated sludge, for biological waste water treatment is described. The system is characterized by highly efficient oxygen utilization, reduced construction size due to the fact that these processes are complied in a single utilization, reduced construction size due to the fact that three processes are combined in a single sludge separation tank, and an automatic oxygen supply regulated by organic impurities concentration. Full-scale demonstration plants confirmed experimental data on plant performance. The oxytank had an oxygenation capacity 3.5 times greater than that for aeration tanks. Because of the use of pure oxygen, the activated sludge concentration can be maintained at 6-10 g/liter at a high dissolved oxygen concentration of 10-12 mg/liter. The settling properties of activated sludge are improved. The oxytank system eliminates the discharge of volatile components into the atmosphere. However, when ammonia stripping is not performed, the ammonium nitrogen content in the oxytank was higher than in aeration tanks. With oxytanks, capital expenditures were reduced by 1.5 to 2 times, and operating expenditures were deto 2 times, and operating expenditures were decreased by 1.4 to 1.6 times. (See also W79-08781) (Small-FRC)

IMPROVEMENTS FOR KRAFT PULP AND MUNICIPAL TREATMENT PROCESSES, Envirotech Corp., Menlo Park, CA. F. P. Sebastian, and D. S. Lachtman. In: 3rd USA/USSR Symposium on Intensification of Bio-Chemical Treatment of Wastewaters, held at Vodgeo Headquarters, Moscow, USSR, on August 23-24, 1976. p 41-50, 1976. 14 fig, 13 ref, 1 append.

Descriptors: *Pulp and paper industry, *Filtration, *Analytical methods, *Recycling, *Energy budget, Municipal wastes, Industrial wastes, Waste water treatment, Carbon, Economics, Monitoring.

Three treatment modifications are discussed for kraft pulp plants and municipal treatment processes. The closed-cycle mill is described which can be a modification of existing kraft mills and totally eliminates contaminated effluents while saving enough through operating expenses to recover its capital expenditures within two years. A high solids filter is described which has application for both municipal and industrial sludge processing. This development can reduce energy consumption and increase energy recovery in sludge thermal systems. The TOC analyzer is described which has applications for industrial and municipal treatment processes. It is a reliable and quick measurement tool that improves waste treatment efficiency through a network of feedforward and feedback control strategies in addition to it application as a monitoring device. (See also W79-08781) (Small-FRC) W79-08789

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Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

BIOLOGICAL WASTE WATER TREATMENT IN THE PRESENCE OF STEROID COM-

POUNDS, Vsesoyuznyi Nauchno-Issledovatelskii Inst. Vo dosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Moscow

(USSR). S. V. Yakolev, and T. A. Karjukhina. In: 3rd USA/USSR Symposium on Intensification of Bio-Chemical Treatment of Wastewaters, held at Vodgeo Headquarters, Moscow, USSR on August 23-24, 1976, p 50-53, 1976. 7 tab.

Descriptors: *Oxidation, *Lipids, *Aeration, *Performance, Biological treatment, Activated sludge, Toxicity.

The possibility was investigated of stimulating bio-logical oxidation in aerobic conditions by the addition of steroid compounds to the water being treated. The steroids methyliestosterone, testosteronepropionate, progesterone, and pregnine were studied using synthetic waste water containing peptone, buffer ammonium salt, and dipotassium hydrogen phosphate. Three sets of experi-ments were carried out: oxidation in Warburg apparatus, synthetic waste water treatment in mixing paratis, synthetic waste treatment in mineralization of activated sludge. The addition of steroids had a marked effect on the BOD value of the waste water measured by the dilution method. The direct addition of the steroids in dry powder form sharply stimulated biological oxidation. Steroids added in alcohol solutions had less effect. Steroids can be used as a measure for the protection of activated sludge bacteria against the action of toxic substances. (See also W79-08781) (Small-FRC) W79-08790

A COMPARISON OF CONVENTIONAL ACTIVATED SLUDGE PROCESS AND PURE OXYGEN ACTIVATED SLUDGE PROCESFOR A 75-MGD SECONDARY TREATMENT FACILITY,

Orange County Sanitation Districts, Fountain Valley, CA.

F. A. Harper. In: 3rd USA/USSR Symposium on Intensification of Bio-Chemical Treatment of Wastewaters, held at Vodgeo Headquarters, Moscow, USSR, on August 23-24, 1976, p 54-59, 1976. 2 fig, 6 tab.

Descriptors: Descriptors: *Activated sludge, *Oxygen, *Sewage treatment, *Costs, *Performance, Municipal wastes, Filtration, Land use, Maintenance.

A pure oxygen system was selected over a conventional air system for a 75 mgd facility because it adequately and economically produced effluent which met state and Federal requirements. The four alternative systems which were considered are described and discussed. These include: air activated sludge, pure oxygen activated sludge, roughing filter and activated sludge, and roughing filter and pure oxygen activated sludge. The pure oxygen activated sludge offered an 18% savings in project cost over the next cost-effective alterna-tive. This system provides a degree of treatment which will meet effluent standards and will provide cost savings in maintenance, operation, and your cost savings in maintenance, operation, and power requirements. Digester gas generated by the facility will provide 5830 horsepower. Also, with this alternative there are savings in land utilization. (See also W79-08781) (Small-FRC)

STUDIES OF ARTIFICIAL AERATION ON THE LITHUANIAN SSR, Kaunasskii Politekhnicheskii Inst. (USSR).

A. L. Skirckiavichus.
In: 3rd USA/USSR Symposium on Intensification of Bio-Chemical Treatment of Wastewaters, held at Vodgeo Headquarters, Moscow, USSR, on August 23-24, 1976, p 60-61, 1976.

Descriptors: *Aeration, *Aerobic treatment, *Rivers, *Performance, Waste water treatment, Water pollution sources, Municipal wastes.

Artificial aeration of the Nevejis River with mechanical C-16 aerators was investigated. The river

was polluted with insufficiently treated waste waters of Panevejis. The aerators which have a capacity of 2.2 kw were mounted from 4 to 9 inches on a metal frame with pontoons. Detailed DO measurements were made at 5 and 10 m distances both upstream and downstream of the aerators. Studies of barbotage aeration were also conducted, and artificial aeration was investigated in tanks. Lower efficiencies were obtained than ex-pected for river aeration. Waste water treatment plants cannot be replaced by artificial aeration, but artificial aeration could be an economical and effective method of partially controlling river DO problems. A larger unit is being tried in the river to eliminate anaerobic areas. (See also W79-08781) (Small-FRC) W79-08792

WASTEWATER TREATMENT CONCERNS OF THE ORGANIC CHEMICALS INDUSTRY IN THE UNITED STATES,

Associated Water and Air Resources Engineers, Inc., Nashville, TN.
C. E. Adams, Jr., and B. T. Sumner.

In: 3rd USA/USSR Symposium on Intensification of Bio-Chemical Treatment of Wastewaters, held at Vodgeo Headquarters, Moscow, USSR, on August 23-24, 1976. p 62-70, 1976. 10 tab.

Descriptors: *Chemical industry, *Industrial wastes, *Regulation, Filtration, Biological treatment, Activated carbon, Performance, Permits.

review is presented of the organic chemicals industry, its waste water characteristics, and waste treatment methods commonly The treatment techniques utilized in the United States and the achievable treatment level proposed by the government are discussed. Biological treat-ment, granular media filtration, and activated carbon adsorption are considered. The problem of issuing permits when there is effluent variability is discussed. (See also W79-08781) (Small-FRC) W79_08793

BIOLOGICAL TREATMENT OF HIGHLY CONCENTRATED WASTEWATERS FROM WOOL-SCOURING OPERATIONS,

Vsesoyuznyi Nauchno-Issledovatelskii Inst. Vodoznabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Moscow

I. V. Skirdov, V. N. Shvetzov, K. M. Morosova,

and L. A. Gubina

In: USA/USSR Symposium on Intensification of Bio-Chemical Treatment of Wastewaters, held at Vodgeo Headquarters, Moscow, USSR, on August 23-24, 1976, p 70-74, 1976. 7 fig. 1 tab.

Descriptors: *Industrial wastes, *Aerobic treatment, *Performance, Anaerobic treatment, Waste dilution, Activated sludge, Aeration.

The feasibility of wool-scouring waste water treatment in digesters followed by final treatment in aeration tanks and complete biological treatment under aerobic conditions was investigated. The studies were conducted on natural waste water generated by a worsted factory where wastes were treated using soap and soda. Laboratory studies demonstrated that treated effluent from digesters with unoxidized organic material content of 3000 mg/liter on a total BOD basis can be treated excessfully without dilution in complete writing successfully without dilution in complete mixing aeration tanks. Also, waste waters with a total BOD of 8000 to 9000 mg/liter can be treated in two-stage completely mixed aeration tanks without preliminary anaerobic digestion and dilution. (See also W79-08781) (Small-FRC) W79-08794

ANALYTICAL AND PROCESS IMPROVE-MENTS IN BIOLOGICAL TREATMENT OF MUNICIPAL WASTE WATERS,

In: 3rd USA/USSR Symposium on Intensification of Bio-Chemical Treatment of Wastewaters, held at Vodgeo Headquarters, Moscow, USSR, on August 23-24, 1976. p 74-78, 1976.

Descriptors: *Monitoring, *Control, *Operations, *Treatment facilities, *Biological treatment, Activated sludge, Industrial wastes, Biochemical oxygen demand.

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Analytical and process control programs for biological treatment plants are outlined, and some problems which have occurred in plant operation are discussed. Process control for a 10 mgd activatare discussed. Process control for a longer activation and the state of sludge plant which treats a brewery waste having 1000 mg/liter BOD is described. Daily, samples are analyzed for TSS, SS, VSS, BOD, COD, TOC, TKN, NH3-N, ortho PO4, DO, pH, temperature, and turbidity. All effluent and process flows are metered and recorded. The data is used flows are metered and recorded. The data is used to adjust the biological process so that effluent standards can be met. Alterations to process control systems because of foaming, capacity upgrading, diurnal variation, septic sewage treatment, and other process modifications are discussed. A pilot study of a proposed lime clarification-biological nitrification advanced waste water treatment process is reviewed. (See also W79-08781) (Small-FRC) W79-08795

DEVELOPMENT AND IMPROVEMENT OF THE MUNICIPAL SEWAGE BIOLOGICAL TREATMENT FACILITIES,
A. Yershov, M. Kyghel, and M. Zemlyak.
In: 3rd USA/USSR Symposium on Intensification of Bio-Chemical Treatment of Wastewaters, held at Vodgeo Headquarters, Moscow, USSR, on August 23-24, 1976, p 78-80, 1976.

Descriptors: *Aeration, *Activated sludge, *Municipal wastes, *Sewage treatment, Flow rate, Performance, Sedimentation, Biochemical oxygen

A new design aeration tank is described which was developed by the Scientific Research Institute for Municipal Economy. Aeration tank-clarifiers were developed which include a system of baffles which provide direct circulation of mixed liquid. The downtake flow rate increases, and an activated sludge, fluidized-bed is formed. The stabilized fluidized bed exists because of the increased recirculation of mixed liquid and the intensification of mass exchange between aeration and clarification zones. Two sizes of the tanks have been developed: for Two sizes of the tanks have been developed: for municipal treatment stations with a capacity of either 1700 cu m/day or 160,000 cu m/day. Total sewage retention time in the tanks was 13 hr at the oxidation rate of 22.6 mg/BOD/g of sludge, and after reconstruction, was 7.73 hr at an oxidation rate of 25.2 mg/BOD/g of sludge. Further modifications of the tanks are planned including increasing the surface of the fluidized bed without increasing the volume. (See also W79-08781) (Small-FRC) FRC) W79-08796

5E. Ultimate Disposal Of Wastes

LEACHING ASPECTS OF OIL SLUDGE BIO-DEGRADATION IN SOIL, Rutgers-The State Univ., New Brunswick, NJ. Dept. of Biochemistry and Microbiology. J. T. Dibble, and R. Bartha.

Soil Science, Vol. 127, No. 6, p 365-370, June 1979. 4 fig, 2 tab, 23 ref.

Descriptors: *Oil wastes, *Sludge, *Biodegrada-tion, Laboratory tests, Lysimeters, Nutrients, Fer-tilizers, Nitrogen, Phosphate, Carbon, Organic compounds, Leachate, Chemical analysis, Waste disposal, Degradation(Decomposition), Soils, Soil science, Oil sludge.

Efficient disposal of waste oil sludges by biodegradation in soil ('land farming') requires management practices that include fertilizer addition. The effect of such practices on soil leachate quality was studied in lysimeter columns containing 5% (wt/wt) hydrocarbon in a soil-sand mixture. Fertilizer was added in various formulations at a carbon-nitrogen and carbon:phosphorus ratio of 200:1 and 2640:1, respectively. As expected, undegraded hydrocarbons did not appear in the leachate, nor was phosphate eluted from the limed soil-sand mixture. A

Techniques Of Planning—Group 6A

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wick, NJ. June 1979.

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biodegra-The effect was studtilizer was n:nitrogen nd 2640:1. hydrocarwas phos-nixture. A very moderate increase in total organic carbon of the leachate occurred due to hydrocarbon biodegradation. When nitrogen was applied as urea or as a urea-paraffin adduct, 23 and 19% of the added nitrogen were eluted in the leachate, respectively. No nitrogen appeared in the leachate when nitrogen was applied as urea formaldehyde. The above results and additional cited reports indicated that judiciously located and operated land-farming sites are not likely to endanger underground aquifers. (Sims-ISWS)

A MANAGEMENT MODEL FOR DETERMIN-ING EFFLUENT STANDARDS FOR THE ARTI-FICIAL RECHARGE OF MUNICIPAL AND IN-DUSTRIAL WASTEWATERS, Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering. R. Willis.

R. Wills.

In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 287-308, September 1976. 4 fig, 2 tab, 19 ref, 1 append.

Descriptors: *Waste water disposal, *Artificial re-charge, *New York, *Model studies, *Water management(Applied), Mathematical models, Ana-lytical techniques, Industrial wastes, Municipal wastes, Water quality, Water quality standards, Groundwater, Effluents, Sprinkler irrigation, Land use, Planning, Optimization, Water spreading, Land disposal systems, Basin spreading.

Two planning models were developed for the optimal land disposal of wastewater effluents in spray irrigation or basin spreading land disposal systems. The models consider the operation of the disposal systems over an individual (a static model) or a sequence of interdependent disposal cycles (a dynamic model). The objectives of the models were to estimate the required treatment of a given waste load to prevent the possible degradation of the soil or groundwater system. The management models are predicated upon the partial differential equations characterizing mass transport in soils. The models incorporate time-dependent non-equilibrium adsorption and first-order chemical or biochemical reactions. The Galerkin finite-element method transforms the system's transport and admethod transforms the system's transport and ad-sorption equations into systems of ordinary differ-ential equations. The transformed equations, which ential equations. The transformed equations, which are the response equations of the system, are imbedded within the constraint sets of the planning models. The planning models, structured as linear programming problems, determine the optimal effluent standards and the time and spatial variation of constituent concentrations within the soil system. The planning models were applied to a spray irrigation site disposing of food processing waste in western New York. Effluent standards, expressed as the maximum concentration of dissolved organics in the disposal system, were estimated the standards of the disposal system. expressed as the maximum concentration of dis-solved organics in the disposal system, were esti-mated for a range of groundwater quality stand-ards. The effluent standards may be used in the preliminary design and operation of conjunctive ground and surface wastewater treatment systems. (See also W79-08631) (Humphreys-ISWS) W79-08654

5F. Water Treatment and Quality Alteration

AN ASSESSMENT OF OZONE AND CHLORINE DIOXIDE TECHNOLOGIES FOR TREATMENT OF MUNICIPAL WATER SUPPLIES: EXECUTIVE SUMMARY, Public Technology, Inc., Washington, D.C. G. W. Miller, R. G. Rice, C. M. Robson, R. L. Scullin, and W. Kuhn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-288 196, Price codes: A05 in paper copy, A01 in microfiche. Report EPA-600/8-78-018, 1978. 78 p, 19 fig, 6 tab, 38 ref. 2 append.

Descriptors: *Chlorination, *Ozone, *Water treatment, *Potable water, *Europe, Surveys, Treat-

ment facilities, Operation and maintenance, Odor, Taste, Disinfection, Control systems.

Taste, Disinfection, Control systems.

The US EPA's Municipal Environmental Research Laboratory, Drinking Water Research Division, sponsored a study of ozone and chlorine dioxide drinking water treatment technologies currently practiced in Europe and Canada. In addition to 1192 questionnaires sent to European water treatment plants, 20 ozone plants located in Europe were visited by the study team; six Canadian plants were also visited. Most of the plants visited utilized tubular ozonators, primarily the water cooled, horizontal tube type. Contacting systems, control systems, and operation and maintenance requirements are also reviewed. Ozone is currently utilized in more than 1000 water treatment plants worldwide to remove colors, tastes, odors, algae, organics, metal contaminants, turbidity, and to floculate soluble organics and to inactivate viruses. Chlorination of the water often follows ozone treatment to maintain a chlorine residual. In the treatment of water with chlorine dioxide, the oxidant is usually produced from sodium chlorite or treatment of water with chlorine dioxide, the oxidant is usually produced from sodium chlorite or sodium chlorite or sodium chlorite or sodium chlorite water treatment plants in the U. S. utilizing chlorine dioxide were visited. Most of these plants utilize chlorine dioxide to control taste and odor problems or to reduce manganese, and 12 of the plants generate the oxidant from gaseous chlorine and sodium chlorite. A visit was also made to 15 European water treatment plants utilizing chlorine dioxide. The design and costs of some of these chlorination systems are described. (Lisk-FRC) W79-08729

COMPUTER COST MODELS FOR POTABLE WATER TREATMENT PLANTS,
Municipal Environmental Research Lab., Cincinnati, OH. Water Supply Research Div.
For primary bibliographic entry see Field 6B.
W79-08807

MARKETABLE EFFLUENT PERMITS FOR THE CONTROL OF PHOSPHORUS IN-FLUENT INTO LAKE MICHIGAN, Wisconsin Univ.-Madison. Social Systems Re-For primary bibliographic entry see Field 6C. W79-08809

5G. Water Quality Control

NONPOINT SOURCE CONTROL GUIDANCE, HYDROLOGIC MODIFICATIONS.
Environmental Protection Agency, Washington,

DC. Water Planning Div. For primary bibliographic entry see Field 4D.

WATER QUALITY GUIDELINES FOR ACID MINE DRAINAGE AND STRIP MINE AREAS

Energy and Mineral Resources Research Inst., Ames, IA. Dept. of Animal Ecology. For primary bibliographic entry see Field 5B. W79-08611

LEACHING ASPECTS OF OIL SLUDGE BIO-DEGRADATION IN SOIL, Rutgers-The State Univ., New Brunswick, NJ. Dept. of Biochemistry and Microbiology. For primary bibliographic entry see Field 5E. W79-08629

ENVIRONMENTAL EFFECTS OF WESTERN COAL COMBUSTION PART I - THE FISHES OF ROSEBUD CREEK, MONTANA, Montana Fish and Game Dept., Miles City. For primary bibliographic entry see Field 5A. W79-08657

A NEW UNITED STATES BIOMONITORING SYSTEM FOR THE AQUATIC ENVIRON-

Akademiya Nauk URSR, Kiev. Inst. Hidrobiolo-For primary bibliographic entry see Field 5A. W79-08661

SILVICULTURAL CHEMICALS AND PROTECTION OF WATER QUALITY.
Oregon State Univ., Corvallis. School of Forestry.
For primary bibliographic entry see Field 5C,
W79-08769

URBAN RUNOFF TREATMENT METHODS, VOLUME I - NON-STRUCTURAL WETLAND TREATMENT, Hickok (Eugene A.) and Associates, Wayzata, For primary bibliographic entry see Field 6F. W79-08773

AREAWIDE ASSESSMENT PROCEDURES MANUAL, VOLUME I, Environmental Protection Agency, Cincinnati, For primary bibliographic entry see Field 5A. W79-08797

AREAWIDE ASSESSMENT PROCEDURES MANUAL VOLUME II, Environmental Protection Agency, Cincinnati, For primary bibliographic entry see Field 5A. W79-08798

AREAWIDE ASSESSMENT PROCEDURES MANUAL, VOLUME III, Environmental Protection Agency, Cincinnati, For primary bibliographic entry see Field 5A. W79-08799

6. WATER RESOURCES **PLANNING**

6A. Techniques Of Planning

THE ROLE OF CONSERVATION IN WATER SUPPLY PLANNING,
Southern Illinois Univ. at Carbondale. Dept. of

Southern Illinois Univ. at Carbondale. Dept. of Geography.
D. D. Baumann, J. J. Boland, J. H. Sims, B. Kranzer, and P. H. Carver.
Prepared for U.S. Army Engineer Institute for Water Resources, Fort Belvoir, Virginia, April 1979. IWR Contract Report 79-2. 123 p, 16 tab, 87 ref. DACW72-78-C-D022.

Descriptors: *Water conservation, management(Applied), Water policy, water supply, Project planning, Conservation, Evaluation, Analytical techniques, Environmental effects, Methodology, Water utilization, Water resources

A definition of water conservation is formulated, the adequacy of knowledge on the available conservation measures is assessed, and the requirements and needs for implementation are identified. Conservation is attained when a measure results in a reduction in use and the overall benefits exceed the costs. There are several major weaknesses in-herent in the evaluations of conservation measures nerent in the evaluations of conservation measures because most did not rely on analyses of carefully designed empirical studies. Cost estimates and in-formation necessary for implementation of man-agement and planning measures are poorly under-stood and are a priori at best. Little is known about stood and are a priori at best. Little is known about the range of possible environmental effects of water conservation. Analysis of conservation measures must focus not only upon specific measures, but also upon the effects of combinations of measures. Information requirements, method of analysis, and salient problems are identified; the analytical approach described does not follow the process of traditional water planning procedures. The report provides the conceptual basis of water

Group 6A-Techniques Of Planning

conservation planning and purposes a methodology. The theoretical approach is presented not with the expectation that it will be implemented, but with the recommendation that model plans be prepared and made available to those in the field. (Schaefer-IPA)
W79-08395

A NATIONAL APPROACH TO WATER RE-SOURCES MANAGEMENT, Australian Water Resources Council, Canberra. 1978. 7 p. Australian Government Publishing Serv-ice, Canberra.

Descriptors: *Water management(Applied), *Water resources development, Water resources, Water conservation, Water policy, Australia, Nat-ural resources, Planning, Water supply development, Programs.

Important basic principles and goals underlying the approach to the development and management of water resources in Australia are identified. A of water resources in Australia are identified. A broad framework is provided for the general de-velopment of programs as well as an outline of the main activities likely to be involved. It is recog-nized that in the management of water there is abundant evidence of the interdependence of the elements of the whole environment. Full consider-ation must be given to the effects on estuarine and marine environments in the management stategies marine environments in the management strategies adopted for Australia's inland waters. Social objecadopted for Australia's inland waters. Social objectives and economic efficiency must also be given proper weight. Responsibility for development and management of water resources in the States and Territories rests primarily with the respective governments. Each government also retains the right to determine the basis for implementing particular proposals. (Schaefer-IPA) W79-08601

ION EXCHANGE REACTIONS IMPORTANT IN GROUNDWATER QUALITY MODELS, Geological Survey, Denver, CO. Water Resources

D. B. Grove.

D. B. Grove.

In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 144-152, September 1976. 22 ref.

Descriptors: *lon exchange, *Groundwater, *Model studies, *lon transport, *Chemical reactions, Groundwater movement, Geochemistry, water quality, Path of pollutants, Analytical techniques, Computer models, Laboratory tests, Onsite investigations, Equations.

Ion exchange is an important chemical reaction occurring during movement of solutes through the ground-water system. Equilibrium-controlled ionexchange reactions, including the evaluation of selectivity coefficients, distribution coefficients, and exchange isotherms, are reviewed. When the exchange process is rate controlled, investigators have shown that ion transfer between the fluid and the reaction surface is determined by either film or particle diffusion. Models assuming equilibrium-controlled exchange are simpler than those for the rate-controlled exchange and sometimes sufficient rate-controlled exchange and sometimes sufficient to describe the exchange process. The effect of radioactive decay is illustrated in the general transport equation. Several laboratory and field studies are discussed. (See also W79-08631) (Woodard-USGS)

INTERTEMPORAL CONTROL OF GROUND-WATER IN MULTIAQUIFER MODELS,

Montana State Univ., Bozeman. Dept. of Agricultural Economics and Economics.

O. R. Burt.

O. R. Burt.
In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 279-286, September 1976. 10 ref.

Descriptors: *Aquifer systems, *Model studies, *Groundwater, *Aquifer management, Theoretical

analysis, Optimization, Analytical techniques, Mathematical models, Systems analysis, Water management(Applied), Water storage, Stochastic processes, Dynamic programming, Water control, Economics, Decision making, Water policy.

The multiaquifer storage problem was formulated as a dynamic programming problem from which an approximately optimal decision rule was de-rived analytically. The method of approximation focuses on the unknown function of the functional equation of dynamic programming. The decision rule for a given set of storage levels in the aquifers at a point in time is obtained as the solution of a system of equations equal in number to the number of interrelated aquifers in the model. This apof interrelated aquifers in the model. This approach to multiaquifer management would permit division of a basin into an arbitrary number of interrelated aquifers for modeling purposes, and thus permit relatively precise control of ground-water storage throughout the basin. Importance of the equilibrium state of storage under an optimal decision rule was discussed, particularly as it relates to fixed pumping capacity under stochastic recharge. (See also W79-08631) (Humphreys-ISWS) ISWS) W79-08653

STOCHASTIC MANAGEMENT OF A STREAM-

AQUIFER SYSTEM,
Universidad Nacional Automona de Mexico,
Mexico City. Inst. de Geofisica.

Mexico City. Inst. de Georsica.

W. E. Z. Flores.

In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 309-328, September 1976. 6 fig. 1 to 34 xef.

Descriptors: *Aquifer systems, *Aquifer management, *Model studies, *Conjunctive use, *Mexico, Mathematical models, Surface waters, Analytical Mathematical models, Stratec waters, Analytical techniques, Groundwater resources, Surface-groundwater relationships, Management, Stochastic processes, Decision making, Optimization, Costs, Economics, Risks, Water processes, Decision Economics, management(Applied).

The objective of this study was to develop and evaluate a simple management technique through which the cost of conjunctive operation of surface water and groundwater resources can be mini-mized under the effect of uncertainty. A lumped parameter model represented the physics of the system, and a linear outflow equation simulated the stream-aquifer flow. A subsurface outflow constant related to the response time of the aquifer proved to be an important concept in the simulation process. Furthermore, a drawdown correction was developed to compute the drawdown at wells. In the developing of the management model, dynamics in the operation of the system were obtained by using linear decision rules. The nonlinear optimization linear decision rules. The nonlinear optimization problem (pumping cost dependent on the draw-down and the pumping volume) was solved by an iterative procedure which uses a standard linear programming package. To study the effect of randomness in the system, uncertainties in the water demand, natural inputs and the physical properties of the system were considered. A stochastic differequation governed the system, and some of the statistics were obtained via spectral analysis. In addition, a conditional probability approach was followed to account for a random subsurface outflow constant. Chance constraints were introduced to include probabilities of satisfaction of con-straints. An application to a basin in northwestern Mexico showed the capability of the proposed model in regional management problems involving hundreds of wells and large surface water facilities. sensitivity analysis showed a larger increase in the operational cost due to uncertainty in the water demand than to uncertainty in the aquifer param-eters. (See also W79-08631) (Humphreys-ISWS) W79-08655

FLOW TO WATER-TABLE WELLS DERIVING THEIR DISCHARGE FROM CAPTURE, Geological Survey, Reston, VA. Water Resources

S. S. Papadopulos.
In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 329, September 1976.

Descriptors: *Water table aquifers, *Zone of saturation, *Water loss, *Evapotranspiration, *Aquifer management, Discharge(Water), Drawdown, Groundwater recharge, Water wells, Water level fluctuations, *Water capture.

Unconfined aquifers having a high water table commonly lose a considerable amount of water through evapotranspiration and (or) they cannot accept all the water available for discharge. The rate of this loss depends on the depth of the water table. As the depth to the water table increases, the rate of loss decreases until a depth is reached at which the loss is eliminated. Wells pumping from aquifers initially having a high water table and, consequently, a high evapotranspiration loss can capture part or all of this loss by lowering the water table. Infiltration may also increase, thereby providing additional recharge. The relation between rate of capture and depth to water table can be closely approximated by assuming that capture increases linearly with depth to water table until a maximum rate is reached at a certain critical depth, and that it remains constant, at this maximum rate, maximum rate is reached at a certain critical depth, and that it remains constant, at this maximum rate, for depths greater than the critical depth. On the basis of this assumption, equations can be derived to describe the flow to wells that obtain their yields from capture. These equations can be used to estimate the discharge and the drawdown distribution around such wells. In addition to these single-well equations, equations can be used for designing well networks spaced to attain maximum capture. (See also W79-08631) (Woodard-USGS) W79-08656

MATHEMATICAL MODEL FOR SIMULATING DISCHARGES ON THE SABINE RIVER BETWEEN TATUM AND RULIFF, TEXAS, Geological Survey, Baton Rouge, LA. Water Resources Div For primary bibliographic entry see Field 4A. W79-08695

ELEVATIONS AND DISCHARGES PRODUCED BY A SIMULATED FLOOD WAVE ON THE LOWER SABINE RIVER, LOUISIANA AND TEXAS, CAUSED BY A THEORETICAL DAM FAILURE,

Geological Survey, Baton Rouge, LA. Water Resources Div.

B. L. Neely, Jr., and G. J. Stiltner. Geological Survey open-file report 79-678, April 1979. 15 p. 11 fig. 1 ref.

Descriptors: *Dam failure, *Reservoirs, *Discharge(Water), *Flood flow, *Simulation analysis, Mathematical models, Analytical techniques, Streamflow, Flow rates, Stage-discharge relations, Critical flow, Slopes, Elevation, Louisiana, Texas, *Toledo Bend Reservoir, Sabine River.

The Toledo Bend Reservoir is located on the lower Sabine River between Louisiana and Texas. Two mathematical models were coupled to calculate the flood wave that would result from the theoretical failure of 25 percent of Toledo Bend Dam and route the wave downstream to Orange, Tex. Computations assumed failure (1) at the peak of the 100 years flood when discharges of the Schiese of the 100-year flood when discharge of the Sabine River is 102,000 cubic feet per second and (2) when the average discharge is 10,000 cubic feet per second. Two techniques were used in the dambreak model. The method of characteristics was break model. The method of characteristics was used to propagate the shock wave following dam failure. The linear implicit finite-difference solution was used to route the flood wave following shock wave dissipation. The magnitude of the flow was determined for Burkeville. Bon Wier, Ruliff, and Orange, Tex., along the lower Sabine River. For these sites, respectively, the following peak elevations were calculated: 119, 82, 31, and 13 feet for the 100-year flood and 110, 75, 27, and 9 feet for the average discharge. (Woodard-USGS) W79-08697

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Evaluation Process—Group 6B

WATER-LEVEL PREDICTIONS FOR INDIAN WELLS VALLEY GROUND-WATER BASIN, CALIFORNIA, 1978, Geological Survey, Menlo Park, CA. Water Re-

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Geological Survey, Menlo Park, CA. Water Resources Div.
M. J. Mallory.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225 printed copy \$4.00, microfiche \$3.50. Geological Survey open-file report 79-254, February 1979. 28 p, 11 fig, 2 tab, 14 ref.

Descriptors: *Water wells, *Water levels, *Fore-casting, *Model studies, *Aquifer characteristics, Pumping, Drawdown, Water levels, Groundwater barriers, Groundwater basins, California, *Indian Wells Valley(Calif), Nodal network, China Lake.

wells Valley(Calif), Nodal network, China Lake. Ground-water pumpage in Indian Wells Valley, virtually a closed basin in the Mojave Desert of southern California, has increased gradually since 1945 and presently exceeds the long-term mean annual recharge (perennial supply). In order to aid in the understanding and management of the ground-water basin, a digital ground-water model was constructed by the U.S. Geological Survey. Since the original development of this model, conditions in the basin, including areal distribution and rates of ground-water pumpage, have changed. The results of simulation for the period 1969-76 constitute a second verification of the original model. Calculated heads for 1976 agree with the observed heads, indicating a good calibration of the original model. A predictive simulation for the period 1977-2020 used pumpage values increasing from about 15,500 acre-feet per year to about 26,000 acre-feet per year. The pumpage used in this report reflects a slightly slower growth rate and a more concentrated pattern of development than that investigated when the model was originally developed. The effects of this pattern of pumpage are reflected in the water levels simulated by the model. Predicted drawdowns for 1983 are less extensive but locally more severe than those predicted earlier. The reversal of the hydraulic gradient between China Lake playa and the city of Ridgecrest, as produced by these drawdowns by the year 2020, suggests that the water-quality effects of such drawdowns should be investigated, as this could result in inferior water from the China Lake playa area flowing southward into areas of withdrawal. (Woodard-USGS) W79-08699

OPTIMIZATION OF ENERGY ALLOCATION IN WATER AND WASTEWATER TREATMENT

SYSTEMS,
Ontario Ministry of the Environment, Toronto.
Pollution Control Branch.

G. D. Zarnett. Publication No. W65, 1977. 24 p, 9 fig, 7 ref, 3 append.

Descriptors: *Energy budget, *Systems analysis, *Optimization, *Treatment facilities, Planning, Decision making, Waste water treatment.

cision making, Waste water treatment.

A technique called dynamic programming is presented which can be applied to water and waste water treatment systems for system optimization. It can be used to evaluate plant performance with respect to effluent quality, operating cost, and energy utilization. Multi-stage decision processes are explained, and a multistage optimization system is described. Examples of applications of dynamic programming are presented. One application is the minimization of pipeline pumping energy for water transmission systems. An example of a multi-unit water treatment plant is detailed. The main advantage of dynamic programming is in its sequential stage-by-stage character of computation. Constraints on either the control or state variables actually simplify the computation rather than make it more difficult because the discretized range on the variables is reduced. Disadvantages include the menace of the expanding grid, inadmissible values may result as the calculation propogates. (Small-FRC)

THE PRINCIPLE OF RATIONAL USE OF NATURAL RESOURCES IN THE THEORY OF OPTIMAL PLANNING,

J. Klackova. Eastern European Economics, Vol. 16, No. 4, p 3-23, 1978. 1 tab, 19 ref.

Descriptors: *Planning, *Socialism, *Economics, *Natural resources, *Evaluation, *Theoretical analysis, Optimization, Land, Agriculture, Economic efficiency, Prices, Cadastral, Valuation.

Rational use of natural resources has received increasing attention in socialist countries in recent years, closely linked with developing the theory of optimal planning in a socialists economy. A historical survey of resource economics in the U.S.S.R. is followed by sections on: (1) types of natural resources (raw materials and land), (2) evaluation of natural resources, (3) evaluation of planning and project design calculations, and (4) evaluation of natural resources in the optimal planning system requires: (1) interchangeability of natural resources, (2) unequal efficiency of interchangeable natural resources, and (3) scarcity of resources compared with needs. Two types of prices are usually recognized in connection with differential evaluation of natural resources; and (2) plan or long-range (perspective) evaluation, applied to all insufficiently used and explored resources. In constructing the evaluations two types of natural resources must be distinguished, those whose loss can be compensated for at the present level of scientific and technical knowledge, and those whose loss involves socioeconomic damage that cannot be compensated at present knowledge levels. Economic evaluation of losses in the first case is expressed by a finite magnitude, and in the second by an infinite magnitude. (Lynch-Wisconsin) Rational use of natural resources has received in-

SOVIET METHODOLOGY FOR THE VALUA-TION OF NATURAL RESOURCES, Washington Univ., Seattle. Dept. of Economics. J. A. Thornton. Journal of Comparative Economics, Vol. 2, No. 4, p 321-333, December 1978. 20 ref.

Descriptors: *Soviet Union, *Valuation, *Natural resources, *Methodology, *Economics, *Planning, Economic efficiency, Forecasting, Pricing, Evaluation, Resources development, Governments, Decision making, Optimization, Resource extraction, Manitories. Monitoring.

A draft methodology for the monetary valuation of natural resources in the Soviet national economy was prepared by the Central Economic-Mathematical Institute. Detailed inventories of natural resources are also being produced. The draft methodology is designed for planning and projection. As a planning tool it resolves some methodological difficulties but proposed calculations fall short of dealing with the full problem of dynamic optimization over many sites in an extractive industry. Formulas are calculated on a per-unit basis, and implied cost functions do not allow for substitution between drawdown of resource stocks and quantity of nonresource inputs used in production of a between drawdown of resource stocks and quantity of nonresource inputs used in production of a given rate of extractive output. The Soviets also assume away the dependence of the variable cost function on the initial capital investment in the extractive site and the dependence of each year's cost function on earlier extraction decisions. The draft methodology appears more useful for shortrun pricing problems than for decentralized plan projection. It is most applicable to relatively fixed factors such as land. It is suggested that improved methods for monitoring and policing stock drawdown and the imposition of efficiency rents would potentially improve use of natural resource stocks. potentially improve use of natural resource stocks.
(Lynch-Wisconsin)
W79-08804

DEVELOPMENT OF AN ECONOMICS-BASED METHODOLOGY FOR PROJECTING FUTURE POLLUTION PROBLEMS, Battle Columbus Lab., Columbus, OH. G. S. Stacey, and J. E. Flinn.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-284 337.

Price codes: A09 in paper copy, A01 in microfiche. Report EPA-600-5-78-011, June, 1978. 85 p, 6 fig, 13 tab, 42 ref, 7 append. 68-01-1837.

Descriptors: *Input-output analysis, *Problem identification and ranking, *Toxins, *Industrial production, *Future planning(Projected), *Forecasting, Pollutants, Economics, Methodology, Planning, Human pathology, Economic prediction, Probability, Systems analysis, Warning systems, Toxicity, Projection.

Toxicity, Projection.

Economic input-output analysis is the basis for a methodology of identifying and ranking future pollution problems caused by toxic substances. The methodology focuses on the relationship between technical changes in production/products on one hand and generation/dispersion of toxic substances through such products on the other hand, in order to identify potential products of concern. This economic-based methodology is selected in preference over two other techniques: (1) a toxicology-based approach in which an initial screening is based on the potential toxicological properties of the product of concern and subsequent screening uses economic criteria to rank the products according to characteristics of their use in the economy; (2) a scientific opinion-based approach, involving compilation of information from a review of the literature backed up by polling of expert opinion. The economics-based methodology has three main steps: (1) Ranking of products, socres are obtained for growth, dspersion, technical change and value of the various products, and the top-ranked products are noted for further attention. (2) Identification of chemical and toxic substances content in the top-ranked products. (3) Ranking of substances; the frequency, distribution and quality of all toxic substances are summarized and a 'futures' list of toxic substances is drawn up. (Harris-Wisconsin)

6B. Evaluation Process

GLOBAL DESERTIFICATION AND RANGE MANAGEMENT: AN APPRAISAL, E. G. Van Voorthuizen Journal of Range Management, Vol. 31, No. 5, p 378-380, Sept 1978, 5 ref.

Descriptors: *Range management, *Browse utiliza-tion, *Evaluation, *Descrification, *Vegetation es-tablishment, Variability, Rainfall, Water conserva-tion, Constraints, Political constraints, Environ-mental effects, Grazing, Pasture management.

Range management techniques in the water-stressed arid and semiarid regions of the world in general and in the Sahel in particular have in many cases failed, due not to physical hazards but to social and political obstacles. Range management is put on the defense in this analysis in an effort to determine if range management principles are to blame for desertification of once productive areas in the Sahel and other arid zones or if fundamental range management principles have been violated in the Sahel and other arid zones or if fundamental range management principles have been violated either unknowingly or for the sake of short-term benefits. This evaluation of the Sahelian situation reveals that although conditions are very difficult in this region, managing rangelands for a year-round feed supply for grazing animals is possible by adapting sound range management practices including a greater use of browse species. It is concluded that government and local support is needed for marketing and stock numbers control. (Tickes-Arizona) (Tickes-Arizona) W79-08748

NOTES ON THE SYMMETRY OF TAXES AND SUBSIDIES IN POLLUTION CONTROL, Harvard Univ., Cambridge. MA. A. M. Polinsky.
The Canadian Journal of Economics. Vol. 12, No. 1, p 75-83. February 1979. 4 fig. 12 ref.

Descriptors: *Economics. *Pollution abatement. *Pollution taxes(Charges). *Subsidies. *Regulation. *Symmetry, Equilibrium. Policy, Equity. Compensation, Economic efficiency. Property rights. Pollution rights.

Group 6B—Evaluation Process

Certain aspects of a debate among resource economists regarding the symmetry between pollution taxes and subsidies in pollution control are clarified. Conclusions: (1) Criticisms of long-run effects fied. Conclusions: (1) Criticisms of long-run effects of subsidies do not go far enough, since it is shown that not only does the subsidy induce entrance of an excessive number of firms, but also causes each firm to operate at an inefficient level of production. (2) The subsidy may be assymetric and inefficient even in the short run if policy options are limited politically. The latter would occur if there were a reluctance to subsidire aristing firms which shu reluctance to subsidize existing firms which shut down as a result of the corrective policy. Related down as a result of the corrective policy. Related issues of equity and compensations are also discussed: it is argued that a commonly proposed plan to compensate existing firms on a lump-sum basis for the loss of property rights to pollute due to the tax may not be feasible. When firms are thought to have a right to pollute there are no objections to paying firms which left as a result of the corrective paying firms which left as a result of the corrective policy, but strong objections to paying firms which never produced. It is suggested hypothetically that if firms have a right to pollute, an efficient subsidy could be implemented in the short run, but if firms do not have a right to pollute the tax would be used alone and there would be no need for equity-based compensation. (Lynch-Wisconsin) W79-08803

SOVIET METHODOLOGY FOR THE VALUA-TION OF NATURAL RESOURCES,
Washington Univ., Seattle. Dept. of Economics.
For primary bibliographic entry see Field 6A. W79-08804

THE ECONOMIC VALUE OF RECREATION AND TOURISM, PARK COUNTY, WYOMING, 1976.

Wyoming Univ., Laramie. Agricultural Extension E. P. Lewis.

Wyoming Agricultural Experiment Station Bulletin, No. 604, March 1978, 36 p. 11 tab, 5 ref, 1

Descriptors: *Park County(NY), *Recreation demand, *Tourism, *Economic impact, *Valuation, *Wyoming, National Parks, Crop production, Mining, Manufacturing, Museums, Rodeos, Recreation, Recreational facilities, Resorts, River float trips, Economics, Baseline studies, Model studies,

The recreation-tourism industry in Park County, The recreation-tourism industry in Park County, Wyoming, particularly in Cody, is a well-developed and important component of the total economy. Tourist access to Yellowstone and Grand Teton National Parks is directly through the county. Recreation and tourism-related businesses directly provide 948 full-time employment equivalents (FTEs), 15% of total county employment, and indirectly provide 774 FTEs. Such businesses contribute \$39.3 million to total Park County output (11% of all direct economic activity). Use output (11% of all direct economic activity). Use output (11% of all direct economic activity). Use of an economic base model shows that changes in the recreation industry would affect a wide cross-section of other local businesses; two illustrations are given. The four primary industries in the county are agriculture, mining (including oil and gas extraction and production), light manufacturing, and recreation-tourism. Five recreation-tourism sectors are identified: (1) trade (gasoline, groceries, liquor, clothing, souvenirs, etc.), 349 FTEs and 53.07 million; (2) eating, dinking, and lodging, 435 FTEs and \$5 million; (3) dude ranches and outfitters, 63 FTEs and \$1.1 million; (4) resorts and odges. 60 FTEs and \$1.1 million; and (5) other lodges, 60 FTEs and \$1.1 million; and (5) other recreational services (museums, river float trips, rodeos), 41 FTEs and \$1.4 million. This report represents an update of an input/output economic base study published in 1977. (Lynch-Wisconsin) W79-08805

COMPUTER COST MODELS FOR POTABLE WATER TREATMENT PLANTS,

Municipal Environmental Research Lab., Cincinnati, OH. Water Supply Research Div. D. L. Guttman, and R. M. Clark. Available from the National Technical Information Service, Springfield, VA 22161 as PB-287 744, Price codes: A04 in paper copy, A01 in microfiche. Report EPA-600/2-78-181, September 1978. 58 p, 11 fig, 26 tab, 7 ref, 1 append.

Descriptors: *Water treatment, *Potable water, *Water purification, *Computer programs, *Computer models, *Costs, Chlorine dioxide, Chlorinaputer models, "Costs, Uniorine dioxide, Uniorina-tion, Chloramination, Ozone, Operating costs, Maintenance costs, Capital costs, Safe Drinking Water Act, Cost analysis, Water quality control, Chloroform, Trihalomethanes, Treatment facilities.

Computer programs were developed to determine costs for five different unit treatment techniques aimed at encouraging public water utilities to meet the legal and aesthetic standards of the Safe Drinking Water Act: (1) chlorination; (2) chlorine dioxide: (3) chloramination; (4) ozone; and (5) granular activated carbon. The five computer programs have been used to calculate costs of removing chloroform and other trihalomethanes from drink-ing water (described in a companion report). Costs generated by these programs are categorized as capital costs and operation/maintenance costs. Capital costs include: construction for site preparation, plant construction, legal services, fiscal and administrative services, interest during construction, and start-up. Operation/maintenance costs include: chemical and raw material needs, labor, utilities, and annual replacement of expendables. Costs are adjusted to current dollars using U.S. Environmental Protection Agency's Sewer and Sewage Treatment Plant Construction Cost Index and the Wholesale Price Index. Values for certain design variables are given so that a test run can be made on the program and compared to sample printouts shown in an appendix. A final table in each section shows costs for each treatment process at five different flow rates. (Harris-Wisconsin) W79-08807

EVALUATION OF ECONOMIC BENEFITS OF RESOURCE CONSERVATION,

Environmental Law Inst., Washington, DC R. C. Anderson.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-286 973, Price codes: A04 in paper copy, A01 in microfiche. Report EPA-600/5-78-015, September 1978. 42 p, 2 fig, 2 tab, 43 ref. R803880-01-1.

Descriptors: *Natural resources, *Recycling, *Market value, *Economic efficiency, *Prices, Conservation, Hotelling model, Scarcity, Rate of extraction, Optimal pricing, Elasticity of demand, Elasticity of supply, Discount rates, Regulation, Social values, Resource depletion, Withdrawal.

Basic tenets of the conservation movement in genreal and the currently-popular recycling activity in particular are that most resources (1) are too cheap; (2) are wastefully exploited; and (3) shall soon become exhausted, depriving future generations of their use. Central to these points are the value placed on undeveloped virgin natural re-sources, whether competitive markets for natural resources establish prices which correspond to the actual social value of the resource, and whether differences between market prices and social values can be estimated. An intensive review of the literature of resource economics uncovers wide-spread disagreement with the classic Hotelling model, in which the optimal price of a resource is treated as the sum of the lease value and the marginal social cost of extraction, and in which market forces are assumed to be in neutralizing equilibrium. Market forces for which price effects can be estimated show little distortion between actual and optimal prices. However, market forces act in varying directions and with varying intensity over time. It is also difficult to measure the magni-tude or even the direction of bias given to the prices acting on supply and demand. Finally, the socially optimal level of resource depletion and conservation is likely to be viewed differently from one generation to another. (Harris-Wisconsin)

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

THE CAPITAL COSTS OF INDUSTRIAL POL-LUTION CONTROL, DE LA Rue (Robert E.) Associates, Santa Clara, CA.

R. E. De La Rue, and E. A. De La Rue. Pollution Engineering, Vol. 10, No. 12, p 47-52, December 1978. 5 tab.

Descriptors: *Capital costs, *Water pollution control, *Air pollution, *Solid wastes, *Economics, *Industrial wastes, *Regulation, Waste treatment, Waste disposal, Industries, Utilities, Forecasting, Pollution abatement, Energy, Oil industry, Metals, Chemical industry, Pulp and paper industry, Costs.

Industry's cost of pollution control facilities rose from \$2.5 billion (3.1% of total capital expenditures) in 1970 to \$6.9 billion (5.1%) in 1977 in response to increasing regulation by the U.S. Environmental Protection Agency and local agencies. Air pollution control is still the largest area of spending, rising from \$1.2 billion in 1970 to \$3.7 billion in 1977 (202% increase); water pollution control costs increased from \$1.1 billion to \$2.8 billion (145% increase), and solid waste disposal from \$11.2 million to \$462 million (313% increase). Pollution control expenditures in 1977 for certain industries were: utilities, \$2.3 billion; chemicals, \$0.7 billion; paper, \$0.4 billion; and machinery, and transportation equipment, \$0.4 billion. These six accounted for 85% of the \$6.94 billion capital expenditure for pollution control by all industries in 1977. Utilities accounted for the largest portion of industrial capital expenditures for pollution, \$0.65 billion (23%); and solid waste disposal, \$0.12 billion (26%). Forecasts for 1978, 1982, and 1985 show that capital expenditures for pollution control will reach \$11.6 billion by 1985, with \$5.7 billion for air pollution, \$5.1 billion for water pollution, and \$0.9 billion for solid wastes. Capital expenditures for 1978 but decline to 5.2% by 1985. (Lynch-Wisconsin) W79-08801

THE OPTIMAL EXPLOITATION OF RENEWABLE RESOURCE STOCKS: PROBLEMS OF IRREVERSIBLE INVESTMENT, British Columbia Univ., Vancouver. C. W. Clark, F. H. Clarke, and G. R. Munro. Econometrica, Vol. 47, No. 1, p 25-47, January 1979. 4 fig. 19 ref.

Descriptors: *Economics, *Capital, *Investment, *Natural resources, *Renewable resources, *Commercial fishing, Mathematical models, Model studies, Nonmalleable capital, Irreversibility, Policy, Common property, Optimization, Fisheries, Resource exploitation, Financing.

Although long-term optimal sustained yield of re-sources is unaffected by capital investment irrever-sibility, short-run dynamic behavior may be significantly affected unless capital is perfectly nonmal-leable with profound implications for rehabilitating overexploited fisheries or other renewable re-source stocks. A new fishery has a short-run phase in which only operating costs are relevant to the management decision. In policy terms, this study supports the accepted belief that in initial developsupports the accepted belief that in initial develop-ment of a common-property resource excessive capitalization is likely to occur, but extreme stock rehabilitation policies such as fishing moratoria may be unwarranted unless the stock is severely depleted. The less that capital assets are transferra-ble the more important this consideration becomes. Previous studies of the economics of renewable resources have explicitly or implicitly assumed that capital stocks are perfectly malleable. Assuming nonmalleability complicates the optimization prob-lem since a minimum of two state variables are lem since a minimum of two state variables are then involved. A model associated with Gordon and Schaefer was employed in the analysis, geared specifically to commercial fishing. (Lynch-WisconW79-088

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MARKETABLE EFFLUENT PERMITS FOR THE CONTROL OF PHOSPHORUS IN-FLUENT INTO LAKE MICHIGAN, Wisconsin Univ.-Madison. Social Systems Re-

M. David, W. Eheart, E. Joeres, and E. David.

Social Systems Research Institute Workshop
Series 7716, December 1977. 35 p, 1 fig, 1 tab, 14

Descriptors: *Permits, *Pollution abatement, *Pollution taxes(Charges), *Lake Michigan, *Wisconsin, *Point sources, *Costs, Water pollution control, Regulation, Legislation, Legal aspects, Water law, Non-structural alternatives, Eutrophication, Waste water treatment, Eutrophication, Waste water treatment, Eutrophication, Waste Pollution Control Act Amendments of 1972(PL 92-500), Effluents, Cost sharing, Economics.

A description of how a system of marketable effluent permits (MEP) can be implemented to achieve desired pollution abatement levels also pinpoints segments of the public likely to derive the most benefit from such permits and illustrates a mechanism for assuring equitable sharing of abatement costs. A general argument for applying MEP in any situation involving abatement of conservative pollutants discharged into stratified bodies of water is illustrated by discussion of the Lake Michigan basin; an MEP system is proposed for Wisconsin in which permits valid for five years (the longest allowed by federal regulations) would use MEP rights as substitutes for changes in plant operations between dates of major operational alterations. The Wisconsin plan for Lake Michigan MEP abatement would have five administrative features; (1) All point sources into the lake basin would be required to own MEPs equal to the amount of phosphorus emitted to the lake. (2) The penalty for exceeding permitted emission levels would be a large daily fine, greater by several magnitudes than the cost of the MEPs. (3) The Wisconsin Department of Natural Resources (DNR) would annually assess total phosphorus load that may be emitted to the lake from point sources. ment of Natural Resources (DNR) would annually assess total phosphorus load that may be emitted to the lake from point sources. (4) DNR would allocated MEPs to the various basin communities so as to assure that overall loading would not be exceeded. (5) Communities with excess MEPs could sell them to localities with MEP deficiencies; the exchange would reallocate the phosphorus load so as to make best of the resources of the basin. (Harris-Witconsis) Wisconsin) W79-08809

EVALUATION OF ECONOMIC BENEFITS OF RESOURCE CONSERVATION, Environmental Law Inst., Washington, DC. For primary bibliographic entry see Field 6B. W79-08810

6D. Water Demand

ANALYSIS OF WATER USE IN THE KROKO-DIL RIVER SYSTEM, Department of Forestry, Pretoria (South Africa). D. W. van der Zel. South African Forestry Journal, No. 103, p 8-14, December 1977. Presented at the Annual Congress of the South African Association for the Advance-ment of Science, Nelspruit, August 1976. 2 fig. 3 tab, 8 ref.

Descriptors: *Water utilization, *Rivers, River systems, Water management(Applied), Water resources development. Water consumption(Except consumptive use), Consumptive use, Krokodil River, South Africa, Natural use, Natural resources, Water distribution(Applied), Ecosystems.

Water use in the biosystem of the Krokodil River in the Eastern Transvaal is examined. The catchment covers 10,526 sq km of broken and mountainous land. The biosystem consists of three main areas: (1) a cool, moist, pastural highveld, (2) a cool, wet, forrested escarpment zone, and (3) a hot,

dry lowveld with subtropical vegetation. The biosystem was broken into eleven subsystems for purposes of analysis and identification. Annual rainfall for the biosystem totaled 9,077.7 million cu m; annual water importation from the neighboring Komati River totaled 3.3 million cu m. Total water use for the 58,590 ha under irrigation was 911.9 million cu m, or 479.7 million cu m more than under the natural situation. An additional 1,380.8 million cu m was used for the 144,360 ha under plantations. About 13.4 million cu m more water was used by dry lands (31,458 ha) than was used by the natural bush if replaced. Separate water use estimates given for the eleven subsystems should be correct to within about 1096. Two possibilities exist for improving on the scarcity of water: more efficient management of present water applications, and more efficient management of land for the specific purpose of water production. The former includes substituting concrete irrigation pipe lines for open earth furrows, regular thinning and pruning of tree stands, timing of clearfellings, and careful scheduling of irrigation. (Schaefer-IPA) IPA) W79-08501

INVESTING IN WATER, Water, No. 25, p 17-20, March 1979. 2 fig.

Descriptors: *Water supply, *Loans, *Financing, England, France, Italy, European investment bank, Reservoir construction, Economics, Water re-sources development, Irrigation programs, Water pollution control, European economic community.

An examination by the European levestment Bank (EIB) of the ways the more than 675 million pounds sterling loaned by the bank to the water industry has been spent is presented. Between 1970 and 2000, fresh water consumption in the European Economic Community (EEC) is expected to rise by about 60%. A high level of investment is needed to ensure adequate water supplies. Loans have been used for water supply schemes, irrigation, and sewerage/antipollution projects; two-fifths of the EIB money has gone to the United Kingdom. The EIB, under the treaty of Rome, channels finance into projects assisting regional development and assists projects of common interest to several member states of the EEC as a whole. A major anti-pollution project for the Rhine is one example. Italy has benefited from EIB financing; projects financed have improved the conditions for attracting both large and small industrial ventures. In Italy, the Pertusillo aqueduct, the Monte Cotugno reservoir, irrigation schemes, and a huge anti-pollution project in the Bay of Naples were financed by EIB. France has received money for the latter. In the United Kingdom, money has gone to water supply and sewerage works; these are detailed. (Schaefer-IPA)

THE MOSAIC THAT TURNED INTO A UNI-FIED INDUSTRY,

C. D. Andrews. Water, No. 25, p 24-28, March 1979. 5 fig.

Descriptors: *Water supply, *Water policy, *Water resources, England, Water resources development, Waste water disposal, Water quality control, Water distribution(Applied), Management, Administrative agencies, National Water Council, National Water Authority

The water industry in England and Wales is surveyed since its reorganization in 1974. In that year the 1,600 separate authorities that administered water services in England and that had not yet been amalgamated were reorganized into ten multipurpose regional water authorities. They were re-sponsible for the integrated development and man-agement of every aspect of the hydrological cycle-water resources; water distribution and supply; sewerage and sewage treatment; the prevention of prollution; river management; land drainage; flood protection and sea defenses; recreation; fisheries; and in some cases navigation. The National Water Council (NWC) provides a central co-ordinating, consultative, and advisory service. Further reorga-nization would replace the NWC with a National

Water Authority and would incorporate research, planning, and data units. The supply of water, resources behind the supply, disposal of waste water, quality control, the distribution network, and land drainage, agriculture, fisheries, recreation, and amenities are discussed. Manpower, personnel problems, and expenditures are reported. Theoretically, the level of service depends on the customers' readiness to pay for those services; in practice, most authorities feel they are rendering good service for a good price, while most customers feel they could run the show better themselves. (Schaefer-IPA) W79-08589

WATER IN MISSOURI, Department of Natural Resources, Jefferson City, MO. Div. of Geology and Land Survey. For primary bibliographic entry see Field 2A. W79-08613

6E. Water Law and Institutions

PROCEDURES FOR COMPLYING WITH EXECUTIVE ORDER 11988 ON FLOODPLAIN MANAGEMENT AND EXECUTIVE ORDER 11990 ON PROTECTION OF WETLANDS, Department of Agriculture, Washington, DC. Federal Register, Vol. 43, No. 112, p 25322-25324, Friday, June 9, 1978.

Descriptors: *Flood plains, *Wetlands, *Protection, *Legal aspects, United States.

Agencies of the Department of Agriculture are developing policies and procedures for complying with Executive Order 11988 and Executive Order 11990. The Department of Agriculture hereby gives notice of its proposed policy for compliance with the two Executive Orders. (Stihler-Mass) W79-08542

PROCEEDINGS OF THE WATER PLANNING WORKSHOP 1978 HELD IN MELBOURNE, 29-30 MARCH 1978,

Workshop 1970s, Workshop held under the auspices of the Department of National Development, Australian Water Resources Council. 1978. Australian Government Publishing Service, Canberra.

Descriptors: *Water resources, *Planning, *Water policy, Australia, Workshops, Publications, Water management(Applied), Water demand, reuse, Baseline studies, Water conservation.

reuse, Baseline studies, Water conservation.

The overall objective of the Water Planning Workshop was to examine water resources planning principles in Australia, without undue bias towards planning procedures used in the U.S. Proceedings of the workshop, including summaries of the findings of syndicate sessions are presented. Also included are a copy of the keynote address, a background paper for the workshop, and copies of all papers presented at address sessions of the workshop. The program was divided into two areas: a review and analysis of current water planning in Australia, and development of desirable approaches. Each area was divided into three sessions: an introduction, a discussion, and a presentation of reports. It was agreed that improvements were needed on current planning methods; financial, environmental, administrative, and legal aspects should be considered early in the planning process. Planning should be more flexible and responsive to changing conditions, uncertainty and public needs, priorities, and aspirations. A strong need was seen for a public education program in the area. A key area for immediate action was the deficiencies in baseline data relating to other disciplines in comparison to water resources data. Some principles and guidelines developed by syndicate groups of the workshop are presented. (Schaefer-IPA)

ADVANCES IN GROUNDWATER HYDROL-

For primary bibliographic entry see Field 2F.

Field 6-WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

W79-08631

DEVELOPMENTS IN GROUNDWATER LAW.

DEVELOPMENTS IN GROUNDWATER LAW, Wyoming Univ., Laramie. Coll. of Law. F. J. Trelease. In: Advances in Groundwater Hydrology; Proceedings of Symposium held at Chicago, Illinois, 1976. American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota, p 271-278, September 1976. 27 ref.

Descriptors: *Water law, *Groundwater, *Water rights, Legal aspects, Legislation, Groundwater

Groundwater law has changed its form a number Groundwater law has changed its form a number of times in the past and will continue to develop in the future. Originally, rules of ownership gave a free hand to developers and settled squabbles between neighbors. Later, rules of reasonable use protected rural users from withdrawals by cities and forced the cities to pay for harm done. Then, prior appropriation and other methods of limiting new uses and withdrawals were adopted. These rules have been used to solve the problems of lowered water tables and artesian pressure main. rules have been used to solve the problems of lowered water tables and artesian pressure, maintaining a 'safe yield', groundwater mining and correlation of groundwaters and streams. Recent developments noted include statutes limiting withdrawals to recharge in Idaho, South Dakota, and Montana; Virginia's new prior appropriation law; the new Nebraska state controls; and Oklahoma's new property rules. The latest phase of Arizona's problems was discussed. As new controls and new institutions are needed, and as those needs become pressing, the law will continue to evolve and change to meet those needs and fulfill them. (See also W79-08631) (Humphreys-ISWS) W79-08652

REPORT OF THE ANNUAL YIELD OF THE ARKANSAS RIVER BASIN FOR THE ARKAN-SAS RIVER BASIN COMPACT, ARKANSAS-OKLAHOMA, 1978 WATER YEAR,

Geological Survey, Little Rock, AR. Water Re-

G. L. Ducret, Jr.

Geological Survey open-file report 79-422, 1979. 25 p, 1 fig, 3 tab, 3 ref.

Descriptors: *Interstate compacts, *Interstate rivers, *Arkansas, *Oklahoma, *Streamflow, Flow rates, Gaging stations, Water yield, Runoff, Reservoir storage, *Arkansas River basin.

This report contains computed annual yields and deficiencies of the subbasins as defined in the Ar-kansas River Compact, Arkansas-Oklahoma; actual runoff from the subbasins and depletion caused by runoit from the subusims and dependent major reservoirs in the compact area; and monthly, maximum, minimum, and mean discharges for the 14 streamflow stations used in computing annual yield. (Woodard-USGS) W79-08685

THE IMPACT OF THE SEWER CONNECTION BAN ON BIOCHEMICAL OXYGEN DEMAND AND SUSPENDED SOLIDS AT THE NORTH SHORE SANITARY DISTRICT,

N. Drummond, and R. D. Letterman.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-274 688, Price codes: A04 in paper copy, A01 in microfiche. Illinois Institute for Environmental Quality Document No. 72-4, 1972. 47 p. 17 fig, 24 tab, 14 ref, 2 append.

Descriptors: "Municipal wastes, "Legal aspects, "Law enforcement, "Sewerage, "Treatment facilities, State governments, Suspended solids, Biochemical oxygen demand, Performance, Growth

The impact of normal growth on the receiving waters was investigated for the North Shore Sanitary District. Trends in operating efficiency are projected based on estimates of population growth. If treatment facilities are not upgraded, increases in population in the Clavey Road Treatment Plant area would increase the effluent BOD concentra-

tion from 46 to 48 mg/liter. Suspended solids would increase from 47 to 49 mg/liter. Effluent BOD concentration at the Waukegan Plan would increase from 61 to 67 mg/liter and suspended solids would increase from 43 to 45. These increases are for the period from 1972 to 1974. Because the plants were overloaded before the enactment of a sewer connection ban, the effects of the ban have not been significant. Upgrading of the plants would more than offset the increases in BOD and suspended solids that result from new sever connections during two years of normal growth. (Small-FRC) growth. (Small-FRC) W79-08764

NOTES ON THE SYMMETRY OF TAXES AND SUBSIDIES IN POLLUTION CONTROL, Harvard Univ., Cambridge, MA. For primary bibliographic entry see Field 6B. W79-08803

ECONOMIC IMPACT OF REVISIONS OF THE PUBLIC WATER SUPPLY REGULATIONS,

Northwestern Univ., Evanston, IL. Dept. of Civil Engineering. R. S. Gemmell, and T. D. Waite.

Illinois Institute for Environmental Quality, Document No. 78-09, May 1978. 41 p, 10 ref, 5 append.

Descriptors: *Illinois, *Water supply, *Regulation, *Economic impact, *Water quality standards, Cost-benefit analysis, Iron, Manganese, Safe Drinking Water Act, Grants, Illinois Pollution Control Board, Illinois Environmental Protection Agency, Odor, Color, Foaming, Copper, Zinc, Water treatment, Environmental effects, Public health health.

Changes in the rules and regulations of the Illinois Pollution Control Board dealing with public water supplies (R77-13), proposed by the Illinois Environmental Protection Agency, will comply with provisions of the Federal Safe Drinking Act and Drinking Water Regulations. Compliance with the federal regulations will mean eligibility for federal grants under the State Public Water System Supervision Program, amounting to about \$0.9 million. Savings due to avoidance of iron and manganese treatment costs are estimated at \$14.2 million. Other proposed changes involve deletions of maximum allowable concentrations of ten substances affecting the aesthetic quality of water, in order to relieve 491 public water supplies of the necessity of making expensive improvements in their treatment facilities. Effects on health and the environment will be minimal, but aesthetic quality of the water may deteriorate somewhat. Deleted standards are those for odor, color, foaming agents, copper, iron, Changes in the rules and regulations of the Illinois those for odor, color, foaming agents, copper, iron, manganese, and zinc. No effects are foreseen on agriculture or on goods and services, though em-ployment availability and industry will be affected somewhat. (Lynch-Wisconsin) W79-08806

6F. Nonstructural Alternatives

URBAN RUNOFF TREATMENT METHODS. VOLUME 1 - NON-STRUCTURAL WETLAND TREATMENT,

Hickok (Eugene A.) and Associates, Wayzata,

MN. E. A. Hickok, M. C. Hannaman, and N. C. Wenck. Available from the National Technical Information Service. Springfield, VA 22161 as PB-278 172. Price codes: A07 in paper copy, A01 in microfiche. Report EPA-600/2-77-217, 1977. 131 p, 41 fig, 15 tab, 28 ref, 4 append.

Descriptors: *Wetlands, *Storm water, *Urban runoff, "Non-structural alternatives, "Water management(Applied), "Nutrient removal, Water quality control, Phosphorus, Suspended solids, Soil texture, Storm runoff, Municipal wastes, Watershed management, Minnesota.

The detrimental effects of stormwater runoff in the Minnehaha Creek Watershed District in Minneso-

ta, leading to reduced water quality in Lake Minnetonka, may be alleviated by utilization to adjacent wetlands. The non-structural use of wetlands for the retention of phosphorus and suspended solids from urban runoff has been demonstrated as a feasible means of controlling runoff and water quality; the renovation of the stormwater runoff in the wetland occurred by a combination of physical entrapment, microbial transformation, and biological utilization. The wetlands studied has a phosphorus retention capacity about 5.5-times that of soil and retained 77% of all phosphorus and 94% of the total suspended solids entering the site. The physical entrapment of contaminants was attributed to the fine texture of the wetland soil, which is also responsible for reducing the velocity of the groundwater movement. The non-structural use of the wetland for controlling urban runoff had no apparent impacts on the wildlife or vegetation in the area. (Lisk-FRC) W79-08773

6G. Ecologic Impact Of Water Development

THE POST-IMPOUNDMENT ICHTHYO-FAUNA OF THE J. G. STRIJDOM DAM, KWA-ZULU,

Natal Univ., Pietermaritzburg (South Africa). For primary bibliographic entry see Field 2H. W79-08521

ESTUARINE PROCESSES, VOLUME I AND II. For primary bibliographic entry see Field 2L W79-08543

7. RESOURCES DATA

7A. Network Design

ECOLOGICAL INVESTIGATION OF DAMS IN THE UMFOLOZI GAME RESERVE,

Natal Parks Board, Pietermaritzburg (South Africa). Hluhluwe Game Reserve.

R. N. Porter.

Public Works Construction and Transport, p 15-16, April 1978. Presented at a meeting of the South African Institution of Civil Engineers, February 28, 1978. 13 ref.

Descriptors: *Ecosystems, *Network design, *Damsites, National wildlife refuges, Environment, Habitats, Wildlife, On-site data collections, Investigations, Dams, Evaluations, Umfolozi Game Reserve, South Africa, Civil engineering.

An investigation of the environmental impacts of proposed dams in the Umfolozi River Basin is presented. The Umfolozi is the largest river in northern Natal and Zululand, and one of the few major river systems in South Africa in which no northern Natal and Zululand, and one of the few major river systems in South Africa in which no significant development has yet been undertaken. Initially, 39 possible dam sites were recognized after further investigations, a provisional list of 12 possible sites was determined. Six sites are situated to the west of the Umfolozi Game Reserve, two lie to the east of it, and four are within it. The catchment measures 11,330 sq km of the 47,753 ha reserve. Ten different major woody plant communities have been recognized, as well as 48 species of mammals, 37 species of reptiles, 10 species of fish, 9 species of amphibia, and 336 species of birds in the reserve. A matrix approach was adopted for the environmental impact assessment; existing land use activities will be mapped and categorized. Identification of 30 different engineering actions and 36 environmental concern variables gave a possible total of 1,080 interactions. The final matrix for each dam site will be prepared by a small multidisciplinary group; it will then be submitted to a larger group of specialists for independent completion. The approach will be multi-judgmental and will reflect, as far as possible, an unbiased evaluation. (Schaefer-IPA) W79-08522 W79-08522

7B. D

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Evaluation, Processing and Publication—Group 7C

7B. Data Acquisition

ESTUARINE PROCESSES, VOLUME I AND II. For primary bibliographic entry see Field 2L. W79-08543

SNOWPACK GROUND TRUTH, DONNER PASS SITE, SODA SPRINGS, CALIFORNIA, JANUARY 18, 1977, Bittinger (M.W.) and Associates, Inc., Fort Collins, CO.

For primary bibliographic entry see Field 2C. W79-08548

A TECHNIQUE FOR THE DIRECT MEASURE-MENT OF WATER STORAGE ON A FOREST CANOPY, University of Strathclyde, Glasgow (Scotland). Dept. of Applied Physics. For primary bibliographic entry see Field 2B. W79-08577

USE OF INDICES OF DIVERSITY AND HIER-ARCHICAL DIVERSITY IN STREAM SUR-

tab, 35 ref.

Descriptors: *Aquatic environment, *Streams, *Surveys, Species, Diversification, Brillouin's equation, Hierarchical diversities, Ecosystems, Data collections, On-site data collections, Indica-

Indices of species diversity from information theory, the biological theory behind their use, some practical applications, and their potential for contributing to the ultimate goal of reducing the cost and time-lag of biological surveys of the aquatic environment are examined. Brillouin's equation (H) is shown to provide greater insight into the structure of communities, particularly those from stressed environments, than other indices it is more sensitive to low diversities and is not those from stressed environments, than other and is not biased. Use of small replicated samples to study species diversities is likely to be more productive than use of a single species diversity computed from a larger sample. Generic level diversities may provide almost as much information about community studies as species diversity and consequently. nity studies as species diversity, and consequently could save time and money. The ability to partition diversities hierarchically is not confined to taxo-nomic hierarchies. Hierarchical diversities based on trophic-group analysis and functional morphological clasifications are shown to hold promise for applied aquatic ecology. (Schaefer-IPA) W79-08596

FIELD MANUAL FOR RESEARCH IN AGRI-CULTURAL HYDROLOGY. Science and Education Administration, Washing-ton, DC.

Agriculture Handbook No. 224. Revised February 1979. D. L. Brakensiek, H. B. Osborn, and W. J. Rawls, Coordinators. 554 p. 355 fig, 49 tab, 291 ref,

Descriptors: *Hydrologic data, *Projects, *Re-search and development, Data collections, Re-search equipment, Research facilities, Agriculture, Data processing, On-site investigations, On-site data collections, Publications.

A complete set of techniques for the initiation and A complete set of techniques for the initiation and maintenance of hydrologic research projects is presented. Techniques were solicited from experts and adapted from material described in current literature. The field manual is not intended to replace individual instruction by an experienced person, but is to serve as a reference for such instruction. If followed, the manual will allow the user to place the data in a form that will be suitable for potential analyses. The best ways to organize and record data are illustrated by forms. The six chapters deal with precipitation, runoff, climate, sedimentology, geology, and watershed characteristics and soil moisture. Each subject is divided into information regarding installations, field observations/maintenance, data reduction, and data processing. (Schaefer-IPA)

THEMATIC MAPPING, LAND USE, GEO-LOGICAL STRUCTURE AND WATER RE-SOURCES IN CENTRAL SPAIN. Instituto Geografico y Catastral, Madrid (Spain). Available from the National Technical Information Service, Springfield, VA 22161 as E77-10167, Price codes: A13 in paper copy, A01 in microfiche. Final Report, November 1976. 332 p. NASA 28760.

Descriptors: *Remote sensing, *Satellites(Artificial), *Foreign research, Mapping, Data processing, Land use, Soils, Forests, Forest-ry, Geology, Geomorphology, Water resources, *Spain, LANDSAT.

*Spain, LANDSAT.

This final report was submitted to NASA as result of one year of investigations carried out in multidisciplinary mode by the participant organizations for the purpose of studying applications of LAND-SAT-2 data to several scientific fields in central Spain. This project involved the participation of various official agencies and working groups related to the problem of surveying the earth surface for their own scientific application. Instituto Geografico y Catastral is the agency that holds the coordinative function in Project No. 28760, with the contribution of 7 other organizations. The items of investigation studied were the following: (1) cartography, (2) digital processing, (3) edaphology, (4) forestry, (5) geology, (6) geomorphology, (7) land use, (8) remote sensing techniques, and (9) water resources. As the general objective was defined, the research in various disciplines by means of LANDSAT-2 data taken over central Spain was for the purpose of developing an operational methodology able to contemplate future space programs as a valuable working tool in the knowledge of the earch disciplines. Every working group has conducted the investigation applied to his own area of interest, but all the participant organizations have the benefit of an exchange of know-how and continuous contact between their scientific personnel. Furthermore, the techniques and equipand continuous contact between their scientific personnel. Furthermore, the techniques and equipment available have been exploited in common. (Sims-ISWS) W79-08608

CHEMICAL COAGULATION DOSAGE CON-

TROL,
Civil and Environmental Engineering Development Office, Tyndall AFB, FL. Detachment 1
(ADTC).

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A042 388, Price codes: A03 in paper copy, A01 in microfiche. Report CEEDO-TR-76-44, 1976. 28 p. 4 fig. 4 tab, 31 ref.

Descriptors: *Coagulation, *Water quality, *Analytical techniques, *Indicators, *Zeta potential, Turbidity, Chemical oxygen demand, Electrophoresis, Water quality control, Waste water treatment, Municipal wastes, Water treatments, Polyelectro-

A control procedure for determining the best coagulant dosage based on retain water quality indicators was investigated utilizing secondary waste water effluent and raw water. The coagulants studied were aluminum sulfate, ferric chloride, ferric sulfate, sodium aluminate, a cationic polyelectrolyte, two anionic polyelectrolytes. The indicators used included zeta potential, colloidal titration, apparent color, true color, CDD reduction, turbidity reduction, and bacteriophage reduction. The method of isoelectric point location of titration was compared with the electrophoretic mobility method; both methods were compared with observed best co-A control procedure for determining the best co-

agulant dosages for physical and bacteriophage tests. Results of the study indicated that the colloidal titration technique and electrophoretic mobility methods did not always produce correlative data. Neither method of isoelectric point location corresponded well with the best coagulant dosage for the physical and biological indicator parameters. The best dosage for turbidity reduction was not the same as the best dose for bacteriophage removal, and hence turbidity and isoelectric points should al, and hence, turbidity and isoelectric point should be considered approximate methods for calculating coagulant dosages. Further research in this area of study was considered necessary. (Lisk-FRC) W79-08740

COMPARISON OF DIFFERENT METHODS FOR MEASURING SOIL SALINITY UNDER FIELD CONDITIONS, Indian Agricultural Research Inst., New Delhi. Water Technology Center. B. R. Yadav, N. H. Rao, K. V. Paliwal, and P. B.

S. Sarma. Soil Science, Vol. 127, No. 6, p 335-339, June 1979. 1 fig, 1 tab, 16 ref.

Descriptors: *Saline soils, *Salinity, *Measure-ment, Instrumentation, Sampling, Conductivity, Root zone, Statistical methods, Regression analy-sis, Salinity sensor, Pressure vacuum cup, Satura-tion extract method.

Soil salinities measured by salinity sensor (EC sub s), pressure vacuum cup (EC sub p), and bulk soil conductivity (EC sub a) were compared with those measurements obtained by the saturation extract method (EC sub e) in a field experiment. There was a significant correlation between EC sub a, EC sub s, and EC sub p, each with EC sub e. The soil resistivity method appears to be quite appropriate for surveying large tracts of salt-affected soils using these regression equations. (Visockysoils using these regression equations. (Visocky-ISWS) W79-08757

IMPROVEMENTS FOR KRAFT PULP AND MUNICIPAL TREATMENT PROCESSES, Envirotech Corp., Menlo Park, CA. For primary bibliographic entry see Field 5D. W79-08789

PROPERTIES OF AN AQUATIC MICRO-ECO-SYSTEM: I. GENERAL INTRODUCTION TO THE PROTOTYPES, Amsterdam Univ., (Netherlands). Limnology Lab. For primary bibliographic entry see Field 5C. W79-08816

7C. Evaluation, Processing and Publication

AQUIFER TRANSMISSIVITY FROM SURFICIAL ELECTRICAL METHODS, Illinois State Geological Survey, Urbana. P. C. Heigold, R. H. Gilkeson, K. Cartwright, and P. C. Reed.
Groundwater, Vol. 17, No. 4, p 338-345, July-August 1979, 7 fig, 2 tab, 15 ref.

Descriptors: *Transmissivity, *Glacial aquifers, *Resistivity, *Illinois, Geophysics. Electrical studies, Hydraulic conductivity. Darcys law. Permeability, On-site investigations, Particle size, Aquifer characteristics, Aquifer testing, Glacial sediments.

Recent advances in the automatic inversion of vertical electrical sounding data offer the opportunity to describe the relationship of the resistivity of a granular aquifer to its hydraulic conductivity. This type of relationship, together with aquifer thickness, can be used to determine the transmissivity of the aquifer. Vertical electrical soundings and pump-test data along the axis of a glacial outwash aquifer in central Illinois have indicated an inverse relationship between aquifer resistivity and hydraulic conductivity. This relationship has been attributed to differences in sorting of the outwash sediments. But studies of granular aquifers deposited in other geologic environments are Recent advances in the automatic inversion of deposited in other geologic environments are

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Group 7C—Evaluation, Processing and Publication

needed before meaningful generalizations can be made. (Visocky-ISWS) W79-08623

RELATIONSHIP BETWEEN SUMMER MEAN AND MAXIMUM CHLOROPHYLL A CONCENTRATIONS IN LAKES,

Colorado State Univ., Fort Collins. Dept. of Civil For primary bibliographic entry see Field 5A. W79-08628

SUMMARY OF HYDROLOGIC DATA COL-LECTED DURING 1977 IN DADE COUNTY,

FLORIDA, Geological Survey, Tallahassee, FL. Water Re-Div. J. E. Hull.

Geological Survey open-file report 79-514, 1979. 91 p, 59 fig, 8 tab, 18 ref.

Descriptors: *Hydrologic data, *Streamflow, *Groundwater, *Canals, *Water quality, Water supply, Water utilization, Aquifers, Water wells, Water levels, Water yield, Saline water intrusion, Chemical analysis, Nutrients, Radiochemical analysis, Pesticides, *Dade County(FL).

During 1977 rainfall was 1.52 inches above the long-term average in Dade County, Fla. Ground-water levels ranged from 0.3 foot above to 0.1 foot below average. The highest and lowest ground-water levels for the year were 1 foot below and 1 foot above their long-term average. In the Hialeah-Miami Springs area, water levels in wells near the Maini Springs area, water levels in wells near the centers of the heaviest pumping ranged from 7.2 to 11.9 feet below mean sea level, 1929; and in the Southwest well-field area, ground-water levels near the centers of pumping ranged from 1.0 foot above to 1.5 feet below mean sea level. In 1977 the combined average daily discharge from nine major streams and canals that flow eastward into tidal waters was 1,712 cubic feet per second (cfs), 46 cfs waters was 1,712 cubic teet per second (cfs), 46 cfs above the combined average daily flow for 1976. The combined average daily flow through the Tamiami Canal outlets was 582 cfs, 201 cfs above that of 1976. The 1977 position of the salt front in the coastal part of the Biscayne aquifer was about the same as in 1976, except south of Homestead Air Force Base where the salt front had encroached farther inland. (Woodard-USGS)

MAP SHOWING GROUND-WATER CONDITIONS IN THE KAIBITO AND TUBA CITY AREAS, COCONINO AND NAVAJO COUN-TIES. ARIZONA--1978.

Geological Survey, Tucson, AZ. Water Resources Div

C. D. Farrar.

Geological Survey Water-Resources Investigations 79-58 (open-file report), March 1979. 1 sheet, 11

Descriptors: *Groundwater resources, *Aquifer characteristics, *Water wells, *Water levels, *Water quality, Hydrogeology, Maps, Groundwater availability, Water yield, Water analysis, Dissolved solids, Fluorides, Arizona, *Coconino County(Ariz), *Navajo County(Ariz).

The Kaibito and Tuba City areas include about 2,500 square miles in north-central Arizona. Ground water is obtained from the N aquifer and from alluvium. The N aquifer consists of Navajo Sandstone, Kayenta Formation, Moenave Forma-tion, and the Lukachukai Member of the Wingate Sandstone. The main source of ground water is the Navajo Sandstone. Ground-water development has been slight in the areas. In 1977 the estimated ground-water withdrawals were about 350 acrefeet in the Kaibito area and 650 acre-feet in the Tuba City area. Water levels ranged from flowing at the land surface to 1,360 feet below the land surface. The chemical quality of the water in the N surface. The chemical quanty of the water in the N aquifer does not vary greatly in the areas. Dis-solved-solids concentrations in the water range from 101 to 669 milligrams per liter but generally are less than 300 milligrams per liter. Along some of the valleys in the Kaibito and Tuba City areas,

the alluvium yields water to many shallow dug wells. The water levels generally are from 5 to 15 feet below the land surface. Dissolved-solids concentrations in water from the alluvium usually are less than 600 milligrams per liter. Information shown on the map (scale 1:125,000) includes depth to water, altitude of the water level, and specific conductance and fluoride concentrations. (Woodard-USGS)
W79-08688

MAP SHOWING GROUND-WATER CONDI-TIONS IN THE VIRGIN RIVER, GRAND WASH, AND SHIVWITS AREAS, MOHAVE COUNTY, ARIZONA-1976, Geological Survey, Tucson, AZ. Water Resources

G. W. Levings, and C. D. Farrar. Geological Survey Water-Resources Investigations 79-57 (open-file report), March 1979. 1 sheet, 8 ref.

Descriptors: *Groundwater resources, *Aquifer characteristics, *Water wells, *Water levels, *Water quality, Hydrogeology, Maps, Groundwater availability, Water yield, Water analysis, Dissolved solids, Fluorides, Arizona, *Mohave County(Ariz).

The Virgin River, Grand Wash, and Shivwits areas include about 3,250 square miles in northwestern Arizona. Ground water is obtained mainly from the alluvium, conglomerate, and basalt; how-ever, several other formations yield small amounts of water to some wells. In the Virgin River area, of water to some wells. In the Virgin River area, most wells are less than 200 feet deep, water levels range from 17 to 310 feet below the land surface, and well yields range from a few gallons per minute to as much as 2,000 gallons per minute. Springs in the Littlefield area contribute about 70 cubic feet per second of water to the Virgin River. In the Grand Wash area wells are from 35 to 850 cubic feet and Wash area wells are from 35 to 850 cubic feet and wash area wells are from 35 to 850 cubic feet and wash area wells are from 35 to 850 cubic feet and wash area wells are from 35 to 850 cubic feet and wash area wells are from 35 to 850 cubic feet and wash area wells are from 35 to 850 cubic feet and wash area wells are from 35 to 850 cubic feet and wash area wells are from 35 to 850 cubic feet and wash area wells are from 35 to 850 cubic feet and wash area wells are from 35 to 850 cubic feet and wash area wells are from 35 to 850 cubic feet and 350 cubic feet and 3 In the Grand Wash area wells are from 35 to 850 feet deep, and water levels range from 5 to 759 feet below the land surface. In the Shivwits area wells are from 10.5 to 300 feet deep, and water levels range from 10 to 256 feet below the land surface. The chemical quality of the water varies with location and aquifer in the report area. Information shown on the map (scale 1:125,000) includes the principal aquifer that furnishes water to wells and springs, depth to water, altitude of the water level, and specific conductance and fluoride concentrations. (Woodard-USGS) W79-08689

WATER RESOURCES DATA FOR CONNECTI-CUT, WATER YEAR 1977. Geological Survey, Hartford, CT. Water Re-

sources Div

sources Div.

Available from the National Technical Information
Service, Springfield, VA 22161 as PB-296 400,
Price codes: A17 in paper copy, A01 in microfiche.
Geological Survey Water-Data Report CT-77-1,
February 1979. 383 p, 4 fig.

Descriptors: *Connecticut, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1977 water year for Connecticut consist of records of stage, discharge, Connecticut consist of records of stage, discharge, and water quality of streams; contents and water quality of lakes and reservoirs; and water levels and water quality in wells. This report contains discharge records for 50 gaging stations; tidal volume for 1 gaging station; stage only records for 3 tidal-gaging stations; contents for 36 lakes and reservoirs; water quality for 56 gaging stations, 3 lakes, 28 wells, 4 springs, 4 seepage sites, and 1 chemical precipitation station; and water levels for chemical precipitation station; and water levels for 21 observation wells. Also included are 44 crest-stage partial-record stations and 38 low-flow par-tial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as mis-cellaneous measurements. A few pertinent stations (not included above) in bordering States are also included in this report. These data represent that part of the National Water Data System operated

by the U.S. Geological Survey and cooperating State and Federal agencies in Connecticut. (Woo-dard-USGS) W79-08690

WATER RESOURCES DATA FOR IDAHO, WATER YEAR 1977, Geological Survey, Boise, ID. Water Resources

Div. Available from the National Technical Information Service, Springfield, VA 22161 as PB-296 545, Price codes: A99 in paper copy, A01 in microfiche. Geological Survey Water-Data Report ID-77-1, February 1979. 640 p, 21 fig.

Descriptors: *Idaho, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1977 water year for Idaho consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report contains discharge records for 190 gaging stations; stage only records for 2 gaging stations; stage for 6 lakes; contents for 24 lakes and reservoirs; water-quality for 95 gaging stations, 76 partial-record stations, and 287 wells; and water levels for 6 observation wells. Also included are data for 57 crest-stage partial-record stations and 187 low-flow partial-record stations. Additional water data were collected at various sites, not involved in the sys-Water resources data for the 1977 water year for partial-record stations. Additional water data were collected at various sites, not involved in the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Idaho. (Woodard-USGS) W79-08696

8. ENGINEERING WORKS

8A. Structures

MURRAY AND STEWART MEETING TIGHT DEADLINES AT STEENBRAS.

The Civil Engineering Contractor, Vol. 11, No. 9, p 15-18, June 1977. 5 fig.

Descriptors: *Dam construction, *Steenbras Pumped Storage Scheme, Dams, Dam design, Construction, Dam foundations, Excavation, Structures, Concrete dams, Electric power pro-duction, Hydroelectric plants, South Africa.

The construction of the Steenbras Pumped Storage Scheme and the performance of the main contrac-tor Murray and Stewart are examined. The project promotes electricity for peak periods by allowing water to drop from a high level dam through a water to drop from a high level dam through a tunnel and surge shaft to turbines lower down. The water will be pumped back in the off-peaks when there is a surplus of cheap electricity. Savage and Lovemore, one of the two specialist subcontractors, are responsible for the roads, the newly completed high-level dam, and the low-level dam. RUC Mining Contracting Company is responsible for the excavation of machine shafts in the main power station, the 5 m diameter tunnels, and the surge shaft. The kilometer long tunnel lighting the surge shaft. The kilometer long tunnel linking the upper and lower dams has three sections: the low pressure tunnel, the vertical surge shaft, and the high pressure tunnel. The 20 meter diameter ma-chine shafts had to be lined with 50 mm of con-crete for 37 meters of their 49 meter depth. The crete for 37 meters of their 49 meter depth. The shafts could not be lined during excavation so a system was devised to handle placing the lining against a variable rockface with dubious anchorage. Excavations at the power station had to be blasted to a tolerance of 15 centimeters. The project will cost about R41-million at 1974 prices; completion is expected in late 1978. Capacity of the 35 hectare dam will be two million cubic meters of water. (Schaefer-IPA) W79-08507

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ENERGY SPLITTE P. R. Rot The Civi 11, p 263 Specialized Information Center Hydraulics—Group 8B

A TIGHT SCHEDULE AND A FLASH FLOOD. Construction in Southern Africa, Vol. 22, No. 3, p 24-27, June 1977, 5 fig.

Descriptors: *Umtata Dam, *Dam construction, Umtata River, South Africa, Dams, Construction, Dam design, Excavation, Earth dams, Spillways, Engineering structures, Embankments, Flash floods.

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The construction of the R 5.5 million Umtata Dam is examined. Preliminary and engineering designs were drawn for the Transkei Government early in 1976. Work on site was begun by Grinaker Construction in June of that year. An earthfill wall, an un-gated concrete spillway structure and spillway apron on the left abutment, and intake tower and outlet works, and a 3.9 km long delivery pipeline to the Umtata purification plant comprise the main elements of the scheme. The wall is complete; crest length is 650 m and maximum height above foundation level in 35 m; side slopes are 1:3 upstream and 1:2.33 downstream. The spillway has an ogee-shaped profile, a crest length of approximately 160 m, a horseshoe shape, and is concrete-lined. The intake tower is 26 m high, rectangular in shape, and comprises a 3 x 6 m dry well and a control room. The tight schedule and flash floods at the site caused problems. The embankment had to be built during the rainy season and a separate large diversion system had to be devised. During a flood, the coffer dam was breached, the embankment excavation flooded and filled with silt, and a subcontractor lost all his plant and equipment. Despite these problems Grinaker is confident of meeting the October closure date. (Schaefer-IPA) W79-08523

LONDON'S WATER SUPPLY IN THE 21ST

CENTURY,
Thames Water Authority, London (England).
Planning Directorate.

B. Protheroe, and J. Mitchell. Water, No. 25, p 11-14, March 1979. 6 fig. 2 tab.

Descriptors: *Tunnel construction, *Water supply, Tunnel design, Engineering structures, Underground structures, Tunnels, Pipelines, Water conveyance, Water management(Applied), Rehabilitation, Construction costs, Cost analysis, Long-term planning, Planning, Thames Water Authority.

planning, Planning, Thames Water Authority.

The careful look given by the Thames Water Authority at a major part of its water supply and distribution system, and the consideration given to a new tunnel ring main as an alternative to piecemeal replacement are examined. The preferred strategy for long-term planning of the London water supply system must offer economic advantage or must justify additional expense. A water ring main linking the major filtration works has been suggested; about 50 km of new large diameter tunnels in the clay will be needed. This layout would offer considerable operational flexibility, would avoid some of the cost and disruption of laying new or replacement trunk lines, and would cost less than maintaining the present system. An economic comparison is detailed showing costs and savings. The use of wedge block tunnels is ideally suited to London geology. These tunnels can be driven very quickly because the lining is precast and mechanical excavation is used; in 2.5 meter internal diameter tunnels, rates over 400 meters per week have been achieved. Large tunnel mains have not shown any serious problem concerning water quality. Precise alignment of tunnels is to be the subject of further study and site investigation; a construction timetable must take into account vulnerability of existing areas to failure. (Schaefer-IPA)
W79-08587 W79-08587

8B. Hydraulics

ENERGY DISSIPATION BY DAM CREST SPLITTERS,

P. R. Roberts The Civil Engineer in South Africa, Vol. 19, No. 11, p 263-264, November 1977. 4 fig, 1 tab, 5 ref.

Descriptors: *Dam design, *Arch dams, *Spillways, *Spillway crests, Peak discharge, Aeration, Air entrainment, Engineering structures, Model studies, Flow characteristics, Hendrick Verwoerd Dam, Orange River Project, South Africa.

Results of hydraulic model tests of the Hendrick Verwoerd dam crest splitters are presented. Hendrick Verwoerd Dam, in the Orange River Project, South Africa, has a maximum spillway head of 9.1 m and a spillway length of 233.4 m. The major conclusions from the tests include: (1) a splitter head design of 7.3 m performed satisfactorily up to 8.3 m when the splitter and the step were aerated for high heads; (2) splitters significantly reduced scour in the river bed; (3) splitters greatly reduced average pressures at the river bed level; and (4) flow stability improves and noise is reduced when splitters are aerated. Other work established that the angle between the spillway crest and the underside of the splitter was important to splitter performance. The spillway characteristics of 23 splitter-equipped South African dams are tabulated. (Davison-IPA) W79-08503 W79-08503

DOLOS ARMOR UNITS USED ON RUBBLE-MOUND BREAKWATER TRUNKS SUBJECT-ED TO NONBREAKING WAVES WITH NO

ED TO NONBREAKING WAVES WITH NO OVERTOPPING, Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. R. D. Carver, and D. D. Davidson. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A048 434, Price codes: A05 in paper copy, A01 in microfiche. Technical Report H-77-19, November 1977. 85 p, 45 fig, 4 tab, 11 ref, 1 append.

Descriptors: *Breakwaters, *Hydraulic similitude, *Laboratory tests, *Waves(Water), Coastal structures, Model studies, Stability, Wave pile-up, Reynolds number, Coastal engineering, *Rubble-mound breakwaters, *Dolosse, Wave forces, Wave

This report addressed the use of dolos armor on breakwater trunks subjected to nonbreaking waves and with no overtopping. The majority of the tests reported herein were designed to determine the stability coefficient, K, and runup and rundown values for the above conditions. Additional limited tests were conducted to show what effects (1) varying the first underlayer stone material from 1/5 to 1/20 of the armor weight would have on armor stability, wave runup, and wave rundown; (2) placing the dolosse in selected geometric patterns would have on stability; and (3) reducing the number of dolosse used in the cover layer would have on stability. Test results showed that (1) a stability coefficient, K = 31, is reasonable for nonbreaking waves on breakwater trunks; (2) varying the first underlayer stone material from 1/5 to 1/20 the armor weight does not significantly affect the stability or the wave runup and rundown values; (3) of the three geometric patterns considered, only one increased the stability above that of random placement; (4) reducing the number of doiosse in the cover layer does reduce the stability; (5) selective use of dolosse on a 1:1.5 slope may be feasible if the stability is assured by specific model tests; and (6) model tests of dolosse should be designed to eliminate the Reynolds scale effect in the first underlayer as well as the armor cover layer. (Adams-ISWS) W79-08547

CHANNEL FLOW COMPUTATIONS USING CHARACTERISTICS, Lanchester Polytechnic, Coventry (England).

Dept. of Civil Engineering. For primary bibliographic entry see Field 2E. W79-08556

STEADY FLOW PAST PRISM IN RECTANGU-

LAR CONDUIT, Concordia Univ., Montreal (Quebec). Dept. of Me-Chanical Engineering.
C. C. K. Kwok, and P. M. Lee.
Journal of the Hydraulics Division, American So-

ciety of Civil Engineers, Vol. 105, No. HY7, Proceedings Paper 14697, p 845-857, July 1979. 9 fig, 3 tab, 3 ref, 2 append.

Descriptors: *Mathematical models, *Theoretical analysis, *Nozzles, *Orifice flow, Pressure, Drag, Numerical analysis, Model studies, Conduits, Computers, Equations, *Two-dimensional flow, *Streamline, Joukowsky transformation, Conformal transformation.

A general method for evaluating contraction and drag coefficients for a two-dimensional flow through a sharp-edged orifice or past a prism symmetrically located in a rectangular conduit was presented. The method was based upon the free-streamline analysis and used a sector hodograph to cover orifices with various nozzle angles and a Joukowsky transformation to transform a line integral in a complex plane into a definite integral. The same method was applied to predict the pressure distribution on the surface of the prism. Both the predictions and the computed coefficients were in general agreement with the previous findings and with the present experiments. (Bhowmik-ISWS) W79-08557

COMPOUND WEIR DISCHARGE, Science and Education Administration, Minneapo-lis, MN. St. Anthony Falls Hydraulics Lab. F. W. Blaisdell, and C. L. Anderson. Journal of the Hydraulics Division, American So-ciety of Civil Engineers, Vol. 105, No. HY7, Pro-ceedings Paper 14688, p. 817-826, July 1979. 8 fig. 1 ref, 2 append.

Descriptors: *Mathematical models, *Model studies, *Weirs, *Orifice flow, Discharge coefficient, Equations, Spillway crests, Channels, Banks, Spillways, *U-shaped weir, Rectangular and triangular

A mathematical model for computing the discharge over a compound weir was developed by separating the weir shape into geometrical elements, computing the discharge through each element using well-known equations for weirs and orifices, and summing the individual discharges through each element. The method was checked and the discharge coefficients were evaluated by a physical model. The accuracy obtained was well within practical needs. The results obtained suggest that similar methods can be used for related practical applications. The weir modeled was Ushaped in plan. When linearized, the shape was a high level trapezoid superimposed on a low level trapezoid. To prevent overbank flow from dropping into the channel and eroding the channel banks near the spillway, the low weir was sized to have a capacity equal to that of the approach channel at bank-full discharge. (Bhowmik-ISWS) W79-08558

ENLARGEMENT OF MARCUS HOOK AN-CHORAGE, DELAWARE RIVER, Army Engineer Waterways Experiment Station. Vicksburg, MS. Hydraulics Lab. For primary bibliographic entry see Field 2L. W79-08610

SIMULATION OF TRANSIENT SUPERCRITI-CAL CHANNEL FLOW, Kansas State Univ., Manhattan. Dept. of Civil

Engineering.
J. J. Zovne, and C. S. Martin.

Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY7. Proceedings Paper 14708, p 859-875, July 1979, 10 fig. 4 tab, 22 ref. 2 append.

Descriptors: *Numerical analysis. *Open channel flow. *Supercritical flow. *Unsteady flow. *Hydraulics. Stability. Mathematical models. Equations. Model studies. *Method of characteristics. Differential equations. Courant

Two explicit numerical integration methods ap-plied to the characteristics form of the St. Venant equations were investigated for the solution of

Field 8—ENGINEERING WORKS

Group 8B-Hydraulics

transient, supercritical, open-channel flow prob-lems. The characteristics-grid method which has been widely used for transient subcritical problems was found to be unworkable in the supercritical regime. The rectangular-grid method was found to be more useful, but it becomes unstable for mesh spacings greater than 100 ft and for flows exceed-ing the stability. Fronce number, Integrative mething the stability Froude number. Integration methods developed for subcritical transient simulation are, therefore, not readily and universally adaptable to the supercritical regime. (Adams-ISWS) W79-08615

A MODEL FOR CALCULATING STEADY-STATE FLOW IN A WATER NETWORK (MODELE DE CALCUL DE L'ECOULEMENT EN REGIME PERMANENT DANS UN RESEAU D'EAU MAILLE), Societe de Traction et d'Electricite, Brussels (Belgium). Dept. of Research and Development.

Lekane Journal of Hydraulic Research, Vol. 17, No. 2, p 149-163, 1979. 3 fig, 19 ref. 1 append.

Descriptors: *Model studies, *Networks, *Water distribution(Applied), *Systems analysis, Pipelines, Mathematical models, Steady flow, Computer models, Analytical techniques, Foreign research, Distribution systems, Flow, Analysis, Flow rates, Hydraulic conduits, Water pressure, SWANN model, Water network.

Calculation of steady-state pressure and flow distributions in a water network is an important requirement for network operators and planners. The SWAN model described in this report is suitable for simulation of networks comprising pipes, nonreturn and pressure-reducing valves, pumps and storage tanks or reservoirs. Mathematical formulastorage tanks or reservoirs. Mathematical formula-tion of the model was based on description of its hydraulic elements by algebraic equations and nodal topological network analysis procedure. The non-linear model equations were solved by appli-cation of the NEWTON-RAPHSON method. Used in conjunction with sparse matrix triangulari-zation and convergence acceleration procedures, this method can be used to calculate large net-works while maintaining calculation times and the amount of data storage within reasonable limits. amount of data storage within reasonable limits. An application of the SWAN model to test and real networks was presented as an example. (Humphreys-ISWS) W79-08749

8C. Hydraulic Machinery

RECOVERY OF ENERGY FROM THE WATER GOING DOWN MINE SHAFTS.

Chamber of Mines, Johannesburg (South Africa). Environmental Engineering Lab.

A. Whillier.

Journal of the South African Institute of Mining and Metallurgy, Vol. 77, No. 9, p 183-186, April 1977, 2 fig.

Descriptors: *Mine water, *Energy conversion, *Hydraulic turbines, Recirculated water, Industrial water, Water utilization, Entropy, Enthalpy, Ther-mal properties, Water management(Applied), Water reuse, Turbines.

An outline of the influence of energy-recovery systems for downgoing mine service water on the temperature rise of the water, and the cost benefits remperature rise of the water, and the cost benefits arising from the use of such systems are presented. The potential energy of the downgoing water is dissipated by friction into thermal energy. Some of the potential energy of the water could be recovered in a simple water turbine. Such an arrangeered in a simple water turbine. Such an arrange-ment would halve the net pumping power demand to the surface-located refrigeration plant and would halve the increase in temperature of the water, giving a substantial increase in cooling available in the stopes. A Mollier diagram for water in which the energy content (enthalpy) is plotted against entropy is used to calculate friction-al flow. Turbine efficiency is graphically plotted against the temperature rise of water, showing the fraction of total energy recovered. A cost benefit fraction of total energy recovered. A cost benefit example illustrates that pressure-recovery systems are justifiable expenditures. (Schaefer-IPA)

W79-08517

THE USE OF CYLINDRO-CONICAL SET-TLERS FOR THE CLARIFICATION OF UN-DERGROUND WATER. Harmony Gold Mining Co., Ltd. Welkom (South

Africa).
E. C. Hunter, and G. T. C. Emere.
Journal of the South African Institute of Mining and Metallurgy, Vol. 77, No. 10, p 201-206, May 1977. 7 fig, 1 ref.

Descriptors: *Mine water, *Conical settlers, *Deposition(Sediments), Waste water treatment, Mining, Flow rates, Settling velocity, Sedimentation rates, Flocculation, Costs, Hydraulic equip-

ment, Mud.

The performance of conical settlers at the Harmony Gold Mine from 1959 to the present is examined. The settlers, installed for the efficient settling of mud and grit, are now made from fiber glass instead of sheet metal, have an estimated indefinite working life, but cost twice as much to install as those originally in use. Raw water is treated with milk of lime, and the pH value is increased from 6.8 to about 8.5 to reduce corrosion and increase flocculation. The action within the settler is that of countercurrent settling. The use of flocculent became essential when the quantity of water handled increased; an experiment is detailed indicating the advantage of the use of flocculents. Flow rates for conical settlers of up to 9.5 MI/d were achieved during tests, but settling at this rate was unsatisfactory. Flows in the region of 8 MI/d were achieved during tests, but settling at this rate was unsatisfactory. Flows in the region of 8 MI/d were achieved with moderate results. Daily operating costs, based on 27 MI settled per day, was R 4.15/MI. Conical settlers can be placed close to gether because of their superior strength; they therefore occupy a small amount of space where space is at a premium because of gold values. Observation shows less side-wall and general deterioration than theoritized; this means less initial support cost and less subsequents support involverioration than theoritized; this means less initial support cost and less subsequent support involvement. (Schaefer-IPA) W79-08524

8D. Soil Mechanics

ANALYTICAL SOLUTIONS TO THE PROB-ANALYTICAL SOLUTIONS TO THE PROB-LEMS OF TRANSIENT DRAINAGE THROUGH TRAPEZOIDAL EMBANKMENTS WITH DARCIAN AND NON-DARCIAN FLOW, Center for Water Resources Development and Management, Trivandrum (India). For primary bibliographic entry see Field 2F. W79-08575

8E. Rock Mechanics and Geology

GEOLOGY WATER STORAGE STRUCTURES IN AUSTRA-LIAN ARID REGIONS.

New South Wales Univ., Kensington (Australia). F. C. Beavis, J. C. Beavis, and L. M. Reade. The Quarterly Journal of Engineering Geology, Vol. 11, No. 4, p 279-290, 1978, 6 fig. 5 tab, 8 ref.

Descriptors: *Water storage, *Reservoir storage, *Dams, *Water tanks, *Reservoir design, voir construction, *Engineering geology, Reservoir evaporation, Reservoir leakage, Water loss, Hydrogeology, Geologic investigations, Australia.

In arid and semiarid regions where precipitation is low and evaporation high, it is important that small water storage structures be properly designed to minimize seepage losses, maximize storage, and maintain salinity at a minimum. In arid Australia where three types of storage are utilized for stock and domestic purposes: the excavated tank, the ring tank, and a combination of excavated tank and earth dam, it is particularly important that storage facilities be properly sited and designed to suit local materials. The investigation of one such tankearth dam system located near Broken Hill, Australia, is described here to establish a basis for the

location, design and construction of small water storages in arid regions. Although it was not possible to comment on the performance of the tank and dam due to only 30 mm of rain since completion and no runoff, the main geotechnical, chemical, hydrological and meteorological criteria required for assessment within a particular region are elucidated: the nature and depth of weathering, the nature and behavior of the soils and in particular stability, reaction to wetting and drying, and compaction characteristics. Soil chemistry is also significant since this will determine the chemical quality of the water and hence the uses to which it can be put. (Tickes-Arizona)

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

SAFE TO DRINK, Public Health Lab. Service, Truro (England). I. Barrow. Water, No. 25, p 7-8, March 1979.

Descriptors: *Water quality control, *Potable water, *Public health, Domestic water, Water quality standards, England, Environmental sanitation, Human diseases, Publications, Reviews, Sanitary engineering, Water pollution.

The book 'Water supply hygiene - safeguards in the operation and management of public water works in England and Wales' is reviewed and some of the background of its production is presented. The water industry of England and Wales reorganized in 1974 and water supply and sewage disposal were amalgamated. A new dimension with important implications for the safety of water supply appeared with the introduction of multifunctional operations due to the merger. Also, increased water usage and the consequent need for functional operations due to the merger. Also, increased water usage and the consequent need for more recycling, with its attendant potential hazards of pollution, made the monitoring of safe supplies and sources important. The book is an up-to-date code of safety and good hygienic practice which started life in 1939 in response to a serious outbreak of typhoid fever at Croydon two years earlier. Screening of waterworks employees for diseases, improvements in water treatment and examination, and a better understanding of the epidemiology of waterborne infections have helped preamination, and a better understanding of the epidemiology of waterborne infections have helped prevent the spread of disease. Practical precepts for the following are included: the integration of services; the protection of sources of supply, including public access and recreational facilities; works of consist and assistances as well as for materials in repair and maintenance as well as for materials in contact with water; and the supervision of service reservoirs, mains, and valves. (Schaefer-IPA) W79-08586

AN ANNOTATED BIBLIOGRAPHY ON WATER CONSERVATION, Planning and Management Consultants Ltd., Carbondale, IL.

D. D. Baumann, K. Alley, J. Boland, P. Carver,

and B. Kranzer.
Submitted to U.S. Army Engineer Institute for
Water Resources, Fort Belvoir, Virginia, April
1979. IWR Contract Report 79-3, 187 p.

DACW72-78-M-0752.

Descriptors: "Water conservation, "Bibliographies, Publications, Documentation, Abstracts, Planning, Water policy, Water management(Applied), Water, Water distribution(Applied), Water demand.

Recent interest in the role of conservation in water Recent interest in the role of conservation in water supply planning has prompted an urgent need for information in the area of water conservation plan-ing. The currently available literature on water conservation measures was surveyed. About 750 items were reviewed in both published and unpub-lished sources including government, manuals, lished sources including government manuals, pamphlets, research reports, masters theses, doc-toral dissertations, and conference proceedings.

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THEORE PRACTIC WATER Items selected are representative of the major problems in the area. Each item is annotated with the bibliographic reference; a summary for each describes objectives, reports methodology, and summarizes and critically appraises the salient findings. Author index included. (Schaefer-IPA) W79-08594

WORLD DATA CENTER A FOR GLACIOLOGY (SNOW AND ICE), NEW ACCESSIONS LIST NO. 2.
Colorado Univ., Boulder. Inst. of Arctic and Alpine Research.

For primary bibliographic entry see Field 2C. W79-08612

10D. Specialized Information Center Services

ADVANCES IN GROUNDWATER HYDROL-OGY. For primary bibliographic entry see Field 2F. W79-08631

AN INTRODUCTION TO ADVANCES IN GROUNDWATER HYDROLOGY, Illinois Univ. at Chicago Circle. Dept. of Geological Sciences. For primary bibliographic entry see Field 2F. W79-08632

PROGRESS IN RESEARCH ON WELL HY-DRAULICS, Rice Univ., Houston, TX. Dept. of Geology. For primary bibliographic entry see Field 2F. W79-08634

A REVIEW OF THE INTEGRODIFFERENTIAL EQUATIONS APPROACH TO LEAKY AQUIFER MECHANICS, Universidad Nacional Autonoma de Mexico, Mexico City. Inst. of Applied Mathematics. For primary bibliographic entry see Field 2F. W79-08635

ADVANCES AND UNCERTAINTIES IN THE STUDY OF GROUNDWATER FLOW IN FISSURED ROCKS, Rice Univ., Houston, TX. Dept. of Geology. For primary bibliographic entry see Field 2F. W79-08636

STOCHASTIC ANALYSIS OF FLOW IN AQUIFERS, New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience. For primary bibliographic entry see Field 2F. W79-08637

ADVANCES IN GROUNDWATER FLOW MOD-ELING, Illinois State Water Survey, Urbana. For primary bibliographic entry see Field 2F. W79-08640

THE FINITE ELEMENT METHOD IN GROUNDWATER TRANSPORT, Princeton Univ., NJ. Dept. of Civil Engineering. For primary bibliographic entry see Field 5B. W79-08642

DISPERSION IN NON-UNIFORM AND ANI-SOTROPIC POROUS MEDIA, Shell Development Co., Houston, TX. For primary bibliographic entry see Field 2F. W79-08645

THEORETICAL DEVELOPMENTS AND PRACTICAL NEEDS IN THE FIELD OF SALT WATER INTRUSION, North Carolina State Univ. at Raleigh. Dept. of

Civil Engineering. For primary bibliographic entry see Field 5B. W79-08649

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Α.	CENTERS OF COMPETENCE		
	DOE Oak Ridge National Laboratory, Nuclear Radiation and Safety	W79-0852708540	14 U. S. Geologica
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	Environmental Information Services, Inc. (Effects of Pollutants on Aquatic Life)	W79-0865708684	28
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